INDIAN VILLAGE HEALTH

REFERENCE

BY

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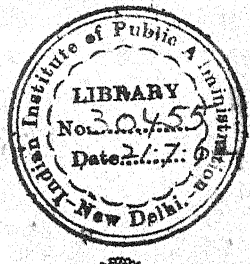

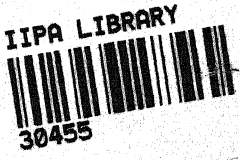

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PLANS

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Chapter I

DISEASES CAUSED BY INSECT BITES

Malaria

'Fever', that is malaria, exists throughout India in varying degrees, and the actual death-rate is always considerable. Occasionally severe epidemics occur over wide areas, causing a tragic rise in the death-rate, completely disorganizing the life and work of the community, and leaving those who recover with lowered resistance to disease, and impaired efficiency. Such a pandemic ravished Ceylon quite recently. Apart from such a tragic visitations, malaria is always present, producing the same results though less dramatically. The disease is preventible and it is quite easy to call attention to areas that have been completely freed of malaria by the application of simple measures. These measures are based on our very complete knowledge of the way the disease is caused and spread.

Here it seems proper to pay a tribute to the years of patient scientific experiments and observation by the research workers in the study of tropical diseases. Sir Ronald Ross worked in his spare time, and at his own expense, and from his day down to the present the best brains in the scientific world have been devoted to these problems. Scientific workers have produced a wonderfully complete and exact demonstration of the causes of almost all the serious diseases met with in India. Knowing the causes it has been a comparatively easy task to devise simple methods of prevention. The Central Government has given every encouragement and ample financial support to research laboratories.

The public health authorities have been active in insuring that those responsible for government, both local

and central, should know of and be induced to apply these simple preventive measures.

No one who has the interests of India at heart can neglect to promote measures for the physical, mental and economic benefit of the people, or be content with inefficiency in preventive campaigns.

To return to malaria. The disease is caused by an animal parasite injected into the blood by an infected female anopheline mosquito. Once acquired malaria causes recurring attacks of severe and debilitating fever. After many attacks the patient is left without resistance to other diseases, and with his vitality so lowered that he may be unfit to support himself.

In children who have, or have had, malaria the spleen is enlarged and easily palpable; consequently an examination of the children of a community readily reveals the percentage suffering from enlarged spleens and is a measure of the local prevalence of malaria.

Records of localities in India where 80 per cent and more of the children have enlarged spleens from malaria are available: surely such areas demand precautionary measures.

The life history of the parasite causing malaria is, very shortly, as follows:

It must be understood that human blood is a thin yellow fluid which gains its red colour from the enormous numbers of red cells (corpuscles) which it contains. An infected female anopheline mosquito, in the act of sucking the blood, injects the young embryo parasites (sporozoites) into the human victim. In the blood and tissues of the victim the parasite goes through various stages of development, incidentally causing fever. In the blood corpuscle the parasite grows, subdivides into twenty or more embryo parasites and destroys the corpuscle, the young embryos thus liberated occupy other corpuscles, and multiplication goes on with recurring attacks of fever.

Some of the parasites develop into the 'sexual' type, different from the former and more resistant to medical

treatment. This form, if taken by a female anopheline mosquito in feeding on human blood, goes through a further stage of development in the mosquito's body, and sporozoites are passed into the new victim bitten by the infected mosquito. Thus the cycle is completed with the advent of the parasite with which this very incomplete description commenced.

It will be appreciated that there are thus in the human patient two cycles going on simultaneously, one, mere self production, causing recurrent fever, easily arrested by quinine and some other drugs, and the other, the dangerous cycle, producing embryos which infect the mosquito that carries the disease to new human victims.

It is obvious that malaria can only exist where there are anopheles mosquitoes. Fortunately not all mosquitoes are suitable for the development of this parasite. All culex mosquitoes are in this matter blameless, and so are some anopheles, but many of the latter are carriers, and in fighting malaria our chief attack is on the anopheles.

Mosquitoes lay their eggs on water. In the water their eggs develop into larvae, the larvae into pupae, and from these come the complete insect. After many years of experience it is accepted that the most vulnerable stage is the larval. The larvae are easily visible, swimming freely in water, feeding and developing, and it is against these that attack is most successful.

The best of all methods is to do away with the breeding places. Small ponds, temporary collections of water and the like can be completely destroyed. Streams, wells, ponds, tanks, canals and irrigated land cannot be done away with. In these the breeding of mosquitoes must be, and can be controlled. It is only comparatively recently that the danger from wells has been fully appreciated. These are the favourite breeding grounds of dangerous anopheles. Wells can in many places be permanently closed, and in towns where a good water-supply system has been introduced they should be closed. When wells are the essential water-supply they can be covered,

rendered mosquito-proof, and fitted with a pump. Roof tanks or cisterns connected with the water-supply must not be forgotten: these must be provided with a mosquito-proof cover or kept under control.

The easiest way to destroy mosquito larvae is to make a film of crude oil and kerosene on the surface of the water. No one would like to spread a film of kerosene or oil on drinking water, and so for wells Paris Green is used. This is an arsenical powder which if used in bulk would be poisonous. One per cent of Paris Green mixed thoroughly with ninety-nine per cent of chalk, or other suitable powder (dry road dust for instance), spreads easily over the water surface, destroys anopheline larvae and is not dangerous to those who drink the water. Incidentally it does not poison fish, or harm vegetation, such as young rice. The best time to apply Paris Green powder to a well is in the evening after the drawing of water is completed. By the morning the larvae have been destroyed and the water is suitable for drinking purposes.

The development of the mosquito from the egg, under the most favourable circumstances, takes eight days, often longer. This is a most important fact for it means that treatment to destroy mosquito larvae will be quite satisfactory if done efficiently once a week.

Apart from wells, and casual collections of water that can be drained, the breeding grounds of anopheles can be kept under complete control by applying crude oil and kerosene once a week to the surface so as to form a thin film. This readily destroys larvae. In streams and drains with a considerable flow a satisfactory film of oil can be achieved by suspending sacking, filled with straw and saturated with the oil, having the lower edge in contact with the water. In place of oil and kerosene certain proprietary preparations are satisfactory and less likely to be stolen. 'Malariol' has given good results.

For efficient application of these larvae destroyers it is necessary to clear the edges of pools and streams. Vegetation such as water hyacinth should be removed.

Prickly pear, the clumps of which are apt to conceal breeding places, can be eradicated very cheaply and completely in a few months by infecting the plant with the larval form of the cochineal insect.

The introduction of larvicidal fish has been reported as successful in some areas but this is not recommended as a routine measure under conditions in India.

While all these activities are directed at the anopheles mosquito, a large proportion of the larvae of culex and other water-breeding insects will be destroyed. During the campaign it is essential to overturn or break any troughs, pans or pots capable of retaining water. In South India toddy pots are thrown about in large numbers and breed culex freely.

The application of the methods so far noted as a systematic campaign is essential for success.

The first step is to make a careful survey of the area; estimating the prevalence of malaria by conducting as complete an examination as possible of all children from three to twelve years of age, and by examining hospital records.

Every potential breeding place must be examined and recorded. Larvae from these breeding grounds must be collected and identified, where necessary, identification being confirmed by breeding out in the laboratory.

At the same time anopheles must be trapped in houses, and dissected in the laboratory, to find out which anopheles are the local carriers of malaria. All this is necessarily the work of a specialist in malaria, and the results of careful observation will do much to ensure success by concentrating on points of danger. If such a specialist is not available the campaign can still be successfully conducted, but the activities must include every potential breeding place and will cover a wider area, entailing some waste of energy and additional expense.

For the actual attack on the larvae the area must be divided into small sub-divisions, as large as can be dealt with by one gang, consisting of a mate and four coolies.

Each potential breeding place is to be treated once a week by the gang. Six of these gangs will work under a Sub-Assistant Surgeon who will supervise and direct their tasks, and collect larvae and mosquitoes for the laboratory. He must interest the people in what is being done, and point out the benefits that will follow.

Over the Sub-Assistant Surgeon will be a special malaria officer, or trained malariologist, with sufficient authority to ensure efficiency. The special malaria officer will require two trained assistants of the Assistant Surgeon grade: one to assist in the laboratory and one to control and issue stores, and to assist in inspections.

No difficulty should be found in enlisting hard working and reasonably intelligent coolies. A very successful plan is to give rewards for good work and to have no punishment except dismissal. By this means it has been possible in Hyderabad to collect a considerable number of honest and hard-working men at the ordinary coolie wage. Quite a large proportion of these men have worked regularly for nine years and have gained a very useful knowledge of the best way to treat each breeding place.

Men who work efficiently, are regular in attendance, and do valuable work are rewarded once a year. Men who attend irregularly, make false claims of work, steal kerosene, or are in any way offensive to the people are eliminated. The people's interest must be aroused and this is best done through informal talks by the special malaria officer and his assistants, as well as by lantern and other lectures. Some women coolies should be employed so that the work can be done on premises where purdah is observed.

Temporary collections of water-breeding anopheline mosquitoes must be drained or filled up. Wells, not necessary for water-supply or irrigation, are better closed. It is far less expensive to cover with well-cemented masonry than to fill up. For wells in use, a cover and pump can be fitted, or the breeding of anopheles controlled by the efficient use of Paris Green once a week.

The powder made of fine dried road dust, with one per cent of Paris Green is easily made in a simple mixing machine, from dust sieved and stored in the hot weather. The workers soon learn to sprinkle the powder, and special sprays are only required for wider surfaces than can be reached by hand.

When building or road mending is in progress special care must be taken to completely drain borrow-pits, or other hollows capable of collecting water. If that is not possible treatment with oil weekly is essential to prevent outbreaks of malaria in labour camps.

The number of men employed and the recurring expenditure on a mosquito campaign are much lessened by undertaking permanent works—closing wells, filling up hollows and borrow-pits, cleaning and canalizing water-ways, and where necessary, reconstructing faulty drains. Efficient surface drainage is essential for combating malaria.

The permanent measures required will vary in different localities. In formulating plans the advice of an expert is necessary and detailed suggestions are beyond the scope of these notes.

Wet crops, such as rice and sugar-cane, should be prohibited in town areas. The greatest danger is from the waterlogged area below the fields under irrigation. Sugarcane fields are less dangerous as they are generally allowed to dry between floodings, but rice fields are kept wet, constituting permanent breeding grounds.

Experiments with rice fields, denied irrigation for two consecutive days a week, proved that mosquito breeding was controlled, and curiously enough in these experiments in the Deccan, the crops, far from being interfered with, showed in some areas an increased yield. These experiments were on a limited scale and there is justification for their continuation on a large scale by the agricultural authorities.

Large irrigation schemes in desert areas like Bikaner and Egypt are not a source of dangerous or uncontrollable

malaria and are obviously of the greatest benefit. There is grave fear of increasing malaria when large tracts of country, already fertile, are provided with abundant water from grandiose schemes. When any large irrigation project is contemplated a malariologist should be employed to make a complete survey, and his considered opinion as to the probable effects on public health should be given careful attention. If it is decided that the work is to be undertaken his views must be given due weight in the details of construction, the quantity and time-table of supply, and, most particularly, as to the draining of the irrigated area. It is essential that the excess of water from the fields be provided with channels that will return over flow to the river-bed below the cultivated area. In an area reasonably fertile from normal rainfall and village tanks, where crop failure only occurs at long intervals, it is a matter for serious consideration whether the problematical increase of yield in crops from wide irrigation justifies a serious risk to the general health. Any excess of water over a considerable area is a very real danger to the health of men and livestock, and an invitation to the development of malaria.

On the regular staff of all large irrigation schemes at work, a specialist in malaria, with the necessary staff, should be appointed. His duties will be to control malaria and other diseases encouraged by a high sub-soil level of water, and to advise where and when irrigation might involve an undue risk.

Personal protection against malaria is of small value compared with the eradication, or at least control, over a wide area, but should not be neglected. The mosquito net is essential for comfort in tropical countries and does much to protect individuals. Mosquito-proof houses are almost unknown in India, but should be provided for those working on the construction of railways, and in settlements in uncontrolled areas.

The prophylactic use of quinine is not generally valued in India. It is highly esteemed in parts of Africa,

and has a definite place when dealing with bodies of men under discipline in malarious situations. The usual plan is to issue a daily dose of six grains of quinine. Success has been reported from a weekly dose of twelve grains in solution. Certainly quinine is more likely to be effective if given in solution and in a dose that will be absorbed in sufficient strength to destroy the parasite.

With the object of destroying the dangerous forms of the parasite and so preventing the infection of mosquitoes and the spread of the disease, Plasmoquin has been used. Used as a prophylactic, no success has so far been recorded even after house-to-house issue of this drug by special volunteers. This is not to imply that Plasmoquin is useless. It is a drug of recognized value in individual cases which show persistent dangerous parasites in the blood.

For ordinary treatment during an attack of malaria quinine is the best remedy. If twenty grains are given in divided doses daily, in a solution slightly acid, and to each dose one drop of *Liquor Arsenicalis* is added, complete cure may be expected after one week's treatment. Usually the temperature falls to normal on the third day. Serious cases, however, with cerebral symptoms, and other complications, need the skill of an experienced physician.

Atebrin is a very efficient remedy for malaria but has some disadvantages, and except if used under expert advice, quinine is to be preferred. The prolonged use of quinine in large doses over a long period is not recommended.

A few practical suggestions may be of value.

(a) Malariol, or any oil and kerosene mixture preferred, should be spread in an unbroken film over the whole water surface. Garden sprays or similar syringes can be used. One expert recommends mixing one part of the kerosene solution with eight parts of coarse sand. This is sprinkled over surfaces and edges of waterways and is claimed to give a more perma-

nent and effective film, and eliminates the expense of an oiling apparatus.

(b) Paris Green can be satisfactorily spread by hand, and the gun or syringe reserved for special situations. Paris Green of a strength of one or two per cent in fine dry road dust is suitable for drinking-water wells, garden tanks, and ornamental ponds or bowls containing goldfish. The two per cent powder, moistened, made into balls and immersed in small pits containing water, will destroy culex as well as anopheles larvae.

(c) A mixing machine for Paris Green powder is readily made by setting a sufficiently well-made wooden box, eccentrically on a rigid frame, with a handle by which it can be freely revolved.

The results achieved in nine years campaign against malaria in Hyderabad may be seen in the following tables, and clearly prove that malaria can be controlled.

STATEMENT OF HOSPITAL ATTENDANCE AT TWO HOSPITALS AND THREE DISPENSARIES

	Total attendance for all diseases	Attendance for Malaria	Percentage of malarial to total attendance
1928-9 (*before campaign*)	170385	82663	47
1929-30	178809	43442	24
1930-1	180454	31024	17
1931-2	238485	37707	16
1932-3	256755	33232	13
1933-4	304829	22236	7
1934-5	296975	15878	5
1935-6	327007	12677	4
1936-7	332942	5760	2
1937-8	340382	3510	1

The large increase in the first column was due to the increasing popularity of the hospitals.

STATEMENT OF SPLEEN 'INDEX'

Percentage of children with large spleens from malaria, in each *mohalla* (ward) of the walled city of Hyderabad, in the Deccan.

		1930-1	1937-8
Yakatpura	...	50	0.4
Charminar	...	46	nil
Paranahavali	...	87	0.8
Dudbowli	...	58	5.7
Mogalpura	...	76	7.3
Chowk	...	67	nil
Lalderwaza	...	40	2.08

Plague

Serious epidemics of plague tend to recur in India each year in August when the temperature falls and humidity increases. If unchecked, the epidemic continues until the onset of the following hot, dry weather in April.

The disease is caused by a microbe and is essentially a disease of rodents. Rats are terribly common in Indian houses and, being very susceptible to plague, are the chief danger. These rats are infested with rat-fleas. Fleas leave the dead plague-rat to feed on human beings and infect them with the disease.

A type of house too common in India is built of sun-dried mud bricks, with a badly constructed tiled or thatched roof, no foundations, and a floor of beaten mud. Such houses make an ideal habitation for rats. The warm climate, and ample food from unprotected stores of grain and vegetables, provide every encouragement to rapid, and quite astonishing, breeding.

To attack plague successfully it is essential to take all possible steps to reduce the number of rats, and to

treat the rat-runs with poisons that will destroy the fleas and flea larvae.

It is essential to prevent people migrating from plague infected centres to clean areas and infecting them. It has been amply proved that plague is most commonly carried from one place to another by families moving and carrying with them bedding containing infected fleas. It is obviously necessary to check this dangerous migration from infected houses and villages. It has been found that in certain areas, which we call 'endemic centres', a few cases of chronic rat plague continue throughout the hot weather and from these an outbreak flares up when the season becomes suitable. Any campaign against plague must include the discovery of, and an attack on, each such area.

The campaign against plague must be continued throughout the year in all large towns that obviously need protection, and in each endemic centre.

Between epidemics, the campaign aims at reducing the rat population, reducing the number of rat-fleas, and improving the housing conditions and providing rat-proof grain stores and markets. All stores of food in houses and shops should be kept in covered receptacles.

If possible a scientific survey of the area is desirable. From this, information will be gained as to the extent of the rat population and the local prevalence of particular species, the proportion of fleas to rats and the presence or absence of rats showing chronic plague. Meteorological conditions affecting plague should be recorded, and any gross faults in house construction that can be remedied.

The actual rat campaign, as carried out in Hyderabad City, and in endemic centres, in the Dominions, is as follows:

The houses in the area are all plotted on a large scale plan, and each house is treated once in six weeks. The treatment consists of baiting for three nights with barium carbonate and trapping for two nights, then every rat-run

is fumigated with calcid powder, blown forcibly through the rat hole, and finally each rat hole is closed with a firm plug of clay.

The barium carbonate is made up with moistened wheat flour into small baits, great care being taken to avoid touching it with the hand, for rats are suspicious and have a keen sense of smell. Each bait is prepared to contain 1.9 grains, twice the lethal dose for a rat, with 8 grains of wheat flour. Six baits are set in an ordinary small room. They are placed in angles and corners readily accessible to rats. The evening is the best time for then the baits are less likely to be disturbed. The number of baits set is recorded and any remaining in the morning are counted and removed. It is a fair presumption that baits taken have been taken by rats, and reasonable to suppose that one rat dies for every two baits taken. Barium carbonate in the quantities used is not dangerous to children or to the larger domestic animals.

The trapping is done with large traps capable of holding a dozen or more rats. The trap is made of strong galvanized wires so close together that a mouse cannot escape. There is an anti-chamber, which a rat can enter and leave freely, having a balanced trap door leading into the trap proper. A sliding door for emptying the trap is provided at the far end and each trap is numbered. Such traps cost about Rs. 2-8. They are strong and last a long time. Once a week the traps must be cleaned, exposed to the sun, and at all times handled as little as possible. Where a laboratory is available, all rats caught are dissected for signs of plague, and each trap found to contain a single rat is covered in a cotton bag and the fleas on the rat carefully counted and recorded.

From the number of rats caught in traps the rise and fall in the rat population, in proportion to the human population, can be estimated, and is a useful measure of progress. The observation of any cases of acute or chronic plague in the rats is an essential indication for further action. The average number of fleas on the rats

gives the 'flea-index' which has a definite bearing on the chances of an epidemic.

Plague occurs when the temperature falls, the humidity increases, the rat population is large and the flea-index high.

The third form of action is the destruction of the fleas in the rat-runs (incidentally many young rats are destroyed), and the closing of the rat holes. Many chemicals have been used for fumigating rat-runs. For some years a preparation known as calcid has been preferred. This is sold in blocks and must be handled with care. A special fumigator is sold with the preparation. It grinds the calcid into a very fine powder and blows it through a tube fitted into the rat hole. Calcid in the presence of moisture gives off hydrocyanic acid gas and is rapidly fatal to rat-fleas, rat-flea larvae and rats in the run. Experiments in artificial runs made under glass for observation prove that the powder reaches a distance of eighteen feet and is a very efficient poison. Other preparations compared in similar experiments were found less efficacious. Hydrocyanic acid is a dangerous poison and the strictest rules as to the use of calcid must be enforced. Only an intelligent assistant who has been carefully trained is allowed to use the machine or to handle the preparation. Great care must be taken that all people and animals are excluded from the house until the fumigation is complete and all rat holes properly sealed. The danger must not be forgotten, and with reasonable care accidents do not occur. In the daily use of this method for three years no accident to a human being has occurred.

The advantages of this method of fumigation are very great and the danger under reasonable precautions very slight.

A preventive measure of great value in plague, and in the general interest, is the removal of slums and the introduction and enforcement of reasonable building laws. These measures can and should be carried out gradually,

and the advantages must be brought to the notice of authority as an essential part of the preventive campaign against plague.

In face of an epidemic, that is as soon as the first rat or human case of plague is reported in a community, immediate action should be undertaken. The notification may come from the laboratory where rats are dissected, it often comes from the gangs employed in preventive measures, and in case of human plague, it should come from the medical attendant. All agencies should be warned to give immediate notification of 'rat falls' or human cases.

On receipt of the report, the house infected and all houses adjoining it, are thoroughly disinfected with an emulsion of kerosene in soap solution (one volume of kerosene to ten of soap solution). This is easy to spray with a garden syringe, finds its way into all corners, is not destroyed by contact with organic matter and is fatal to fleas. These houses are vacated and sunlight and fresh air freely admitted.

All fleas in clothing and bedding are destroyed by free exposure to the sun for two hours.

Secondly, all houses within two hundred yards—the maximum movement of the domestic rat—are baited and trapped, and the rat holes fumigated again, even if this treatment has only just been completed.

At this time everyone in the town or village should be induced to accept anti-plague inoculation. It can hardly be necessary to stress the wonderful protection given by inoculation, or to point out that all employed on plague duty must be inoculated.

The people evacuated from the infected centre are accommodated in huts outside the inhabited site. All large towns subject to outbreaks of plague should have standing camps of huts ready for occupation. These camps should be reasonably comfortable and arrangements for shops and supplies, for watch and ward, and for conservancy, should come into force automatically on

occupation. The benefit, quite apart from the escape from plague, that accrues to the people, and particularly to the children of slum areas, from a move into a health camp, is surprising.

A difficult but essential task is to prevent the migration of people from the infected area to another part of the town, or to some other town or village. Careful watch by the plague gangs and co-operation of authority can do much to prevent this dangerous tendency. In Secunderabad, strict rules regarding the entry of those from notified plague areas, were promulgated and enforced. No visitor was allowed to bring bedding or the like, though large numbers of daily labourers and visitors were allowed entry. Though surrounded by plague infection no single case occurred in Secunderabad after these rules had been enforced, although in previous years Secunderabad had been affected by plague every year.

In short the action demanded in face of an epidemic of plague is:

(a) Inoculation.
(b) Evacuation and disinfection.
(c) Intensive rat destruction.
(d) Prevention of migration.
(e) Efficient reporting.

Plague is a preventible disease. In Hyderabad City before the measures detailed above were introduced, the deaths from plague reported yearly were considerable. In one year more than seventeen thousand and in another year fifteen thousand died. At the height of the former epidemic the deaths from plague reached the appalling figure of five hundred a day. The reporting agencies were so dislocated by the epidemic that it is certain the figures are an understatement.

Since the introduction of the precautions and preventive measures in 1930 the annual deaths from plague have been 1132, 1101, nil, 188, 410, 193, 270 and 48.

These deaths were imported cases or due to small outbreaks originating in infection from outside. In no case after 1932 was it found difficult to prevent any widespread infection.

Filariasis (Elephantiasis)

In many parts of India elephantiasis is quite common, the distressing disfigurement and consequent disability being too well known to require description. The disease, which has other serious forms besides the well-known enlargement of the limbs, is caused by filariae, parasites two or three inches long, living in the lymphatic system in man. The young embryos are found circulating in the surface blood at night. Like malaria the life history of the parasite is completed in mosquitoes, but in this case the culex mosquitoes are involved. The night blood of an infected person containing the embryos is taken by the mosquito. In the mosquito the embryo develops and finally reaches the proboscis. When the mosquito is sucking blood the developed embryo seizes the opportunity to penetrate the skin of the human victim and so the cycle is completed.

The prevention of elephantiasis is essentially the same as the prevention of malaria, that is to say, a scientifically controlled attack on mosquitoes in the larval stage. As however it is now culex larvae that are the enemy, the anti-malaria measures must be extended to destroy culex as well as anopheles larvae. It is of great importance that a careful survey of the infected area should be made, as it is often found that the disease persists in certain villages while neighbouring villages remain free. This is important, as money and effort need not be wasted in extending the campaign far beyond the infected village. The flight of a mosquito is limited even though somewhat extended by the wind. It should usually be sufficient to control the breeding of culex mosquitoes over an area extending three hundred yards from the village.

The methods of destroying mosquito larvae have been fully described in the notes on malaria.

Relapsing Fever

Relapsing fever occurs in epidemic form in India more commonly during the cold weather, and among the lower castes in village life. The disease is characterized by an acute attack of high fever lasting three or four days which tends to recur two or three times after febrile intervals. With each relapse the days of fever tend to be less, and the intervening days without fever more, until the disease disappears.

In most epidemics there are few complications and the death-rate is low, though convalescence may be protracted and debility marked. In epidemics where the spleen is definitely enlarged and jaundice appears, the death-rate may be considerable.

Diagnosis of such a disease found among the *chamar* and outcast *bastis* of a village is not difficult.

In Africa similar and generally more serious epidemics are not uncommon.

The parasite (spirochaeta) can be demonstrated in the blood during the early days of the febrile period. In Africa the intermediary host is a tick, but the Indian variety of relapsing fever is caused by both the body and the head louse.

Prevention should aim at personal and house cleanliness, and the complete separation of clothing and bedding used by the patient. The hair should be shaved or kept meticulously clean and patients, as far as possible, isolated. Infected clothing and bedding should be boiled and completely freed of lice and their eggs, or better still, completely burned.

Curative treatment consists of nursing, simple diet, cleanliness and medicine. Salvarsan and allied preparations are definitely curative, and are best given intravenously. If a doctor is not available, Stovarsol tablets

should be taken. Up to twenty grains a day being suitable for adult patients.

One epidemic was rapidly controlled when the people of the infected part of the village were persuaded that the gods would remove the epidemic if all would shave and burn their hair as a sacrifice.

Chapter II

DISEASES CAUSED BY DRINKING POLLUTED WATER

Cholera

In India, terribly fatal epidemics of cholera sweep through wide areas in the hot weather. The disease is caused by a microbe which develops freely in well-water, especially when it is scanty and polluted during the hot season. The organism also occurs in rivers, canals and village ponds, and may be conveyed on fruit, or food kept fresh by sprinkling with polluted water. Raw fruit is especially dangerous when cholera is present.

The disease can only be acquired by swallowing water or food contaminated with the organism.

The early symptoms of the disease are very violent vomiting and diarrhoea. These discharges are virulently infective, so that any doctor or attendant on a case of cholera must be careful to keep soiled hands away from his mouth, and from contact with food or drinking water. He must meticulously clean his hands and clothing before he resumes ordinary contacts. There is a record of an Indian doctor who, constrained to accept *pan* after treating a cholera patient, paid for his conventional courtesy with his life. The violent vomiting and diarrhoea is apt to soil the surroundings of the patient with virulent infective material, and it is easy to understand how a water vessel from such an infected room, if used also to draw water, will endanger all who drink from the same well.

The infection may also be carried by flies from infected material to food.

It has frequently happened in the past that cholera is brought into new areas by pilgrims, and a very close

watch must be maintained on temples and tanks where large congregations are collecting for religious festivals. In South India peripatetic chairs carry Hindu gods great distances from one temple to another, later returning by a different route. In such journeys crowds of pilgrims are collected and dropped *en route*. Formerly these processions were a recurring cause of introducing and spreading cholera. As soon as the disease broke out the pilgrims scattered to their respective villages many of them carrying infection with them.

The treatment of a case of cholera entails intravenous medication. For personal protection against cholera it is necessary to boil all water for drinking purposes. Where a guaranteed pure water-supply is not available, drinking water should always be boiled, for water carries not only cholera but typhoid, dysentery and other diseases.

Of general measures for preventing cholera the first and most important is to protect the water-supply.

In towns with an efficient water-works, cholera is unknown, but smaller towns and villages depend on wells which are always open to pollution. This pollution becomes more marked and more dangerous in the hot weather, when the supply is scanty. All ordinary surface wells whether draw-wells or step-wells should be treated with potassium permanganate at regular intervals, and particularly when the weather is hot and the water level low.

Close watch must be kept on congregations of pilgrims and on pilgrim processions. Where it is possible, no one should be allowed to take part who has not been inoculated against cholera. The inoculation causes no pain and no inconvenience, and gives protection for one cholera season. The water-supply of the temple and surrounding camps must be controlled, disinfected and, if necessary, increased. Pumps fitted to short lengths of iron tubing driven into sandy river beds increase the local supply and yield a temporary supply of cool drinking water, not easily polluted. Medical officers must be

employed with the Revenue and Police staff to advise on sanitary matters and to watch for cases of illness; hospital huts must be constructed and furnished with essential equipment and menial staff; cases, even suspected of cholera, must be isolated without delay and detained as long as there is any possibility of infection.

In India the times of important *melas* or festivals are well known and pilgrimages take place at regular and known intervals. General sanitary precautions have been established and it is not necessary here to dwell on well-devised measures regarding the position of huts, shops etc., or the provision of wide roadways, kept reasonably clean, and, conservancy arrangements. Nothing will prevent pilgrims from drinking the sacred water of the tank or river when bathing; it is therefore necessary to be very strict in all precautions, to protect and clean the water beforehand, and in the case of rivers, to see that the parts used for washing clothes and for animals is well down stream, away from the part reserved for bathing.

For peripatetic chairs (*palkis*), with pilgrims constantly joining and leaving the procession, special precautions are necessary and, as far as may be, similar precautions should be applied on the route to the large *mela*. A medical officer must accompany the procession and see that all who join it are inoculated against cholera, that the camping grounds are kept in a sanitary condition and cases of illness isolated and treated in reasonable comfort. A medical officer will precede the procession disinfecting all wells with permanganate of potash, and doing all that is possible to have the site of the camp cleaned up, and food of good quality available. Latrines are prepared of the shallow trench type to be filled in every twenty-four hours. A third medical officer will follow the procession to disinfect the wells, clean up the camp sites and look after stragglers. In all these matters there must be close co-operation with the police and other civil authorities managing the festival or procession, and reasonable allotment must be made for

necessary expenditure. By such means cholera which in the past so often resulted from pilgrimages will be prevented.

The activities that are necessary in a village actually infected with cholera must be thorough and persistent. The reporting agency is the village watchman or patel, and in fighting epidemics of cholera, as in all other epidemics, early report, followed by immediate and efficient action is of the utmost importance. Co-operation of all authorities, and of the village people themselves, is necessary to insure very prompt action, and this must be encouraged by all forms of propaganda. Information of the first case of cholera should be sent in a special coloured cover to the nearest police station. From there the information should immediately be forwarded by telephone or runner to the Public Health Officer, or the Civil Surgeon, if he is responsible. The public health staff should be so organized that a medical officer or trained sanitary inspector can arrive in the infected village within twenty-four hours. He should not leave the neighbourhood of the village until it is free of cholera. He will, without loss of time, disinfect every well with permanganate of potash on the same day. If he allows himself to be persuaded to omit even one well it will probably become the favourite for drinking water and the cause of the spread of infection. Water, pink from permanganate of potash, is not harmful. In fact it is a useful medicine in cases of cholera, and there is no excuse for failing to treat every well and every other source of drinking water, such as hollows scooped out in river beds.

The method of adding permanganate of potash to the wells is important. All the crystals should be dissolved before reaching the well-water which should be thoroughly stirred. A method only too common is to put the crystals into a bucket or other vessel attached to a rope and to shake it up and down in the water. The consequence is that most of the crystals, still undissolved, are washed out and sink to the bottom of the well. The proper

method requires two buckets. One has no rope attached and into this the crystals of potassium permanganate are placed. The second bucket, with a rope attached, is used to repeatedly draw water from the well. The water is added to the crystals in the first bucket and only one third of the solution is poured into the well and replenished by water drawn from the well in the second bucket. The process takes about ten minutes and is continued until all the crystals are completely dissolved and the water in the well is thoroughly mixed with the pink solution. The repeated drawing by the second bucket ensures thorough stirring of the water and a complete mixing of the dissolved permanganate. This disinfection of the well does not usually require to be repeated, but if cholera continues to occur it is possible the well has been reinfected by the use of soiled domestic vessels. The disinfection should then be repeated.

Having disinfected all the wells, the medical officer should arrange with the village authorities to prevent any vessel from an infected household coming to the well. The filling of their water vessels can be arranged for at a source some distance away, by people of suitable caste, provided with buckets or *garas* that are above suspicion.

The sanitary officer will then inoculate against cholera all who are willing to accept this safeguard. He will then inspect the whole village and take suitable action against any other source of drinking water—ponds, a canal or a stream. Villagers formerly objected but now almost universally welcome the pinking of wells. A few may be prejudiced and when the water is treated such people may seek their water from some contaminated source. Any such doubtful supply must be brought under control.

The next duty of the doctor is to have friendly and informal talks with the people, showing them how to protect contacts from infection, what food to take and the care necessary to avoid the consumption of any infected food or water. Contacts should be persuaded to accept

inoculation. The discharges of the patients should be disinfected by covering with quicklime and burying outside the house, or by burning after saturation with kerosene.

The medical officer will do all that he can to prevent the villagers, particularly those from infected families, moving to other villages.

As soon as these preventive measures have been completed for the general safety the doctor will treat the individual cases. He should always have with him the apparatus and tablets for intravenous hypertonic saline treatment. Patients have a better chance of recovery if they drink large quantities of water treated with permanganate of potash.

Potassium permanganate can be used to disinfect small village ponds, but larger tanks, rivers and canals cannot be easily disinfected. Many villagers take their water from streams and canals and these may be the source of cholera. Encouraging results have been obtained in such cases by dissolving copper sulphate in the water. The method is to hang muslin bags, each containing half a pound of copper sulphate, at two-yard intervals, on a rope which is then placed across the stream (or dragged through a tank) until the copper sulphate is entirely dissolved. One such rope is used a mile or so above the infected village, and another just below the village down stream. This must be done morning and evening for three days, or if the disease persists, for a longer period.

Outbreaks of cholera in villages can be very quickly checked by the methods mentioned above. It is unnecessary to quote any figures, for every sanitary officer who has used these methods intelligently could quote hundreds of experiences where cholera completely disappeared from the infected village within forty-eight hours. In fact cholera is quite definitely a preventible disease, but still claims thousands of victims in India every year.

Every dispensary and every police station should keep a large stock of potassium permanganate—a very inexpensive salt—and the officers should understand its value as a disinfectant, and should know how to use it. Copper sulphate and lime or kerosene are available in practically every market.

Typhoid

Enteric or typhoid fever is caused by a microbe that multiplies in the human body and is present in the evacuations of patients. The microbe is capable of existence for months in polluted water. It is not destroyed by cold and has been found in ice-cream.

In Canada a virulent epidemic was traced to one case that had occurred in a lonely hut in the hills. The dejecta were thrown out on the snow; when spring came the snow melted and polluted the water supply of the town in the valley below, causing a widespread and tragic epidemic.

Not only during the disease is the patient infective, but a proportion of those who recover are temporary or even permanent ' carriers '. Apart from those who have the disease, or who have recovered, infection may be conveyed by water, milk and milk products, lettuce and unwashed vegetables and fruit, and shell-fish. Oysters have more than once been incriminated.

Enteric is very common in India, and it is not surprising that Indian children, living as many do in insanitary conditions, suffer from the disease. The tendency to infection is less after about the twenty-fifth year. No doubt many have acquired immunity by an attack of the disease before the age of twenty-five. In any case those who work in India are constantly exposed to the chance of infection from a servant or friend who is a 'carrier', from polluted water, milk or improperly prepared food.

Fortunately a simple safeguard is available. The T.A.B. prophylactic vaccine is of the greatest value and gives protection for a considerable time. Before going

to India everyone should be inoculated and the inoculation repeated regularly every two years up to the age of thirty, and after that at longer intervals.

In India all precautions against infection from water, milk and uncooked food should become the routine of all housekeepers. These precautions will be mentioned later when considering personal protection in the tropics. It would be well if all servants employed in dairies, and in the preparation and serving of food, were sent to a laboratory for the tests necessary to prove they are free from infection.

When a case of enteric is being treated it is essential that the attendants should be inoculated and proper precautions taken to protect themselves and others. The microbe is harmless until taken into the body with food or drink.

Bed linen, vessels and everything touched by the patient must be disinfected and all dejecta burned or specially treated under medical advice.

To protect oneself, inoculation with T.A.B. vaccine is essential. While the chances of infection are much reduced by taking reasonable precautions and while the number of cases in a community steadily decreases as progress is made in sanitation, yet the danger of the apparently healthy carrier is always present, and prophylactic inoculation is necessary.

A reduction in the incidence of typhoid in the general population can only be attained by improving the water-supply and removing insanitary conditions, discouraging unhealthy habits, and controlling carriers.

The public health authorities should be able to trace any epidemic outbreak to its source. Such epidemics are usually caused by virulent contamination of a popular source of water-supply.

Paratyphoid is similar in cause and effect to typhoid but is generally milder and less dangerous. The combination of the two infections is common. Protection is conferred by the same vaccine and the precautions

necessary against contaminated water or food are the same.

Dysentery

Apart from certain uncommon forms there are two important types of dysentery, the amoebic and the bacillary. The former is caused by an animal parasite. It is less acute in onset, has a greater tendency to persist and has dangerous complications, including the liver-abscess.

Bacillary dysentery is caused by microbes, that is to say, vegetable organisms or bacilli. Several organisms have been proved to cause bacillary dysentery, consequently there are great difficulties in preparing a preventive or curative vaccine, and too much reliance should not be put on any stock vaccine. If a bacteriological laboratory is available a specific vaccine can be prepared for individual outbreaks.

In bacillary dysentery the onset is usually very acute, but the disease is not so persistent or so dangerous as the amoebic type.

Like cholera and typhoid, both types of dysentery are usually due to polluted drinking water, and are sometimes spread by contaminated food or by flies.

The prevention of dysentery is similar to the prevention of typhoid. General sanitation must be improved, a reliable water-supply provided and the public induced to adopt healthy habits. In bacillary dysentery the patient should be treated by drachm doses of Epsom salts three times a day, and the diet strictly limited to tinned milk well diluted with boiled water. This diet is sterile, and with the Epsom salts, cases rapidly improve; those which persist are probably amoebic and treatment with emetine must be arranged for from the nearest dispensary.

As in typhoid and cholera the discharges should be disinfected.

Guinea Worm

This infection is prevalent in certain areas particularly

where step-wells are common. The disease is caused by a worm which comes to maturity in the human body.

The mature female guinea worm, which is two or three feet long and very thin, breaks through the skin to eject its larval form in thousands. The site of its appearance is in a dependent part and usually in the leg. The ejection of the larvae is stimulated by water; this can readily be seen with the naked eye as jets of milky fluid when water is dribbled over the lesion. Examined with a magnifying glass the milky ejection is seen to contain quantities of freely moving minute larvae.

If a patient with such a lesion enters the water when using a step-well the larvae are ejected into the water in enormous numbers. The cyclops, or waterspider, a small insect just visible to the naked eye, and very common in step-wells, devours the larvae. In the body of the cyclops a further stage in the development of the larvae takes place. When water containing infected cyclops is swallowed by human beings the cyclops is digested and the maturing guinea worm set free to enter the tissues. In the human tissues the guinea worm completes its development and life history, producing the long mature and fertilized female guinea worm. This female, breaking through the skin and ejecting another generation of larvae into water, completes the cycle.

The lesion of the skin is often inflamed and poisoned and in some situations painful and dangerous; in any case the patient is debilitated, and for months unfit for work. The infection is often multiple and the patient continuously ill.

The direct infection of a step-well or village pond is obvious, but a draw-well too may be infected unless the curb is so constructed that water spilt on the legs and feet of those drawing water is prevented from falling back into the well.

Successful prevention of guinea worm must aim at

(a) Conversion of step-wells into draw-wells, and the improvement of draw-wells.

(b) The destruction of the cyclops in the water.

(c) Discouragement of those with the disease from approaching the well for any purpose.

The last is difficult and a matter for propaganda and education. The sufferers should be made to understand that by going to the well they not only infect others but also reinfect themselves.

To destroy the cyclops temporarily is comparatively easy. Formerly it was supposed necessary to add quicklime to the well until a definite degree of heat had been produced. Quicklime is not easy to obtain in many villages and is difficult to keep and carry. After considerable experimental work it has been shown that ordinary slaked lime is quite efficient. The effect however is only temporary, cyclops soon reappear and the lime must be used regularly once a month until the structure of the well has been improved and is free from the threat of reinfection. One drachm of lime for every gallon of water in the well is the quantity recommended.

If cyclops can be excluded from the water-supply for eighteen months no more cases of guinea worm will occur.

Where a modern system of filtered water is available guinea worm disappears. In villages that depend on wells it is essential for guinea worm prevention, as for other water-borne diseases, that the well should be scientifically constructed and kept under efficient and regular supervision. A model well is described later and a plan given after page 90.

Personal protection is simple. Cyclops which convey the disease are readily killed by heat, and therefore boiled water is always safe. Even filtering through fine muslin is sufficient to remove cyclops, the only carriers of the disease.

The prevalence of guinea worm in certain areas is surprising. A survey of eighty villages in South India revealed two thousand one hundred and sixty people who were suffering, or had recently suffered, from guinea worm.

In one village dispensary the attendance for guinea worm for one year was over nine hundred persons, many with multiple worms, and all suffering from a considerable degree of disability. It was possible in that village to get all the step-wells cleaned and converted into draw-wells. In the next year the attendance for guinea worm was three hundred. At the third annual inspection the number had fallen to sixty, and on tracing these, all were found to come from outlying villages.

Chapter III

GENERAL INFECTIONS

Smallpox

In every province, and in all important Indian States, a well organized department will be found for the preparation of vaccine lymph and the vaccination of the people. In most cases vaccination is voluntary and where it is compulsory by law there are difficulties and objections to enforcement. As the organization for the preparation and distribution of vaccine lymph has improved, epidemics of smallpox have decreased, and have come under better control, but the occurrence of considerable and very fatal epidemics of smallpox have not yet been prevented and more efficiency is essential.

While general measures to improve public health, and particularly housing conditions will assist, the only certain method of preventing smallpox in India is the increased protection of children by efficient vaccination. For the most part opportunities for re-vaccination are neglected, and it may be stated quite definitely that full protection will not be achieved until all are vaccinated in infancy, and re-vaccinated about seven years later.

Immediately on receipt of a notification of smallpox the area must be visited by a vaccinator and intensive vaccination and re-vaccination carried out.

These precautions seem quite simple. Unfortunately there are several factors which render the work difficult. One is the firm belief among the ignorant that smallpox is a punishment for sin and a visitation by an offended goddess.

The wide areas, and often scattered population, allotted to one vaccinator present obvious difficulties.

Inspection of these vaccinators, not always honest and industrious, and always on the move, is not easy and not always efficient. The ease with which false returns can be recorded, and the difficulties of checking these records, indicate the necessity of making inspections more thorough and more efficient.

Most of these tendencies can be overcome firstly by interesting propaganda, secondly by enlarging the scope of supervision, including not only doctors, who can check treatment faults, but other officials who can check the written records of journeys, visits and vaccinations.

All civil officials while on tour can do much to encourage and improve the work of vaccinators. Missionaries, and others with influence, can and often do help to overcome prejudice on the part of the people, and to defeat dishonesty or laziness. The acceptance of bribes in money or in kind by vaccinators sometimes needs action. Dishonest and incompetent vaccinators should be got rid of without hesitation. On the other hand certified good work should be rewarded.

It is to be accepted that for the lower grades employed in any form of public health work rewards are far better than punishments.

It should not be forgotten that the vaccinator's life is one of hardship. He is constantly on the move in all weathers and often living in uncomfortable quarters, visiting his own home at long intervals. A factor that will make for efficiency is to ensure the vaccinator a proper salary, good prospects of promotion, and allowances that will cover his travelling expenses with a generous margin.

Complications of vaccination due to dirty methods have to be guarded against. They are often caused by the parents applying mud or clay, or worse, to the scarifications. Every vaccinator should be provided with a simple apparatus for sterilizing his small instrument. A brass spirit lamp and a rest for his scarificator is all

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that is required. First the rest, and then the instrument, is sterilized in the flame of the lamp, and left to cool, while the arm to be vaccinated is carefully cleaned with spirit. Clean cotton wool in a container, also soap and towels for the vaccinator's hands, are of course necessary. The apparatus, the stock of lymph and its date, and the vaccinator's methods, all need to be studied at each inspection.

Propaganda regarding smallpox should receive still more attention than it does at present.

Tuberculosis

Phthisis and other forms of tuberculosis are not very common or the cause of much suffering in Indian villages. On the other hand tuberculosis, particularly tuberculosis of the lungs—phthisis—is appallingly common in Indian cities where the housing conditions are bad and an ill-balanced diet is the rule. The danger is much aggravated by insistence on purdah in small houses. In the large cities the death-rate from tuberculosis is very high. It has been said that the expectation of life of a young girl married into a poor house in Calcutta, and observing purdah, is under three years. This is a statement it would be very difficult to verify, but the mere fact that it has been made is an indication of tragic conditions.

It is interesting that the death-rate from tuberculosis is in inverse ratio to the size of the house. In Edinburgh a few years ago the death-rate per thousand in one-roomed houses was 2.25, in two-roomed houses 1.46, in three rooms 1.11, and in houses of four rooms or larger 0.56. The size of the house is a measure of poverty, and in addition to overcrowding and want of ventilation, nutrition is generally in keeping with the size of the house.

It can hardly be necessary to implore everyone in his or her sphere of influence in India to do everything

possible to promote the supply of institutions for the prevention, treatment and isolation of these infectious cases.

Her Excellency Lady Linlithgow has inaugurated a fund for the control and treatment of tuberculosis and the response has been generous. Work against tuberculosis already existing has been encouraged, and improved and new efforts organized.

There is widespread ignorance regarding tuberculosis and its very infectious nature. It is most important that this ignorance should be dispelled by efficient propaganda. Private talks, dwelling on the necessity of cleanliness, light and fresh air in the house, are of great value. In fact what has been described in England as the 'open-window' campaign. Public lectures with lantern slides, leaflets, pictures and best of all the cinema, should be used in spreading the essential knowledge regarding tuberculosis and its prevention. Pamphlets already widely issued draw attention to the evils of spitting, and point out the necessary arrangements for a generous diet, light, ventilation and open-air exercise.

Steady and consistent work and considerable expenditure is necessary to improve housing conditions. Municipalities, City Improvement Boards, Town Planners and all authorities should work together to remove slums, open up congested areas and to provide well-planned and well-ventilated houses for the poorer people. At the same time strictly enforced building laws will correct the faults in the houses of the rich.

The prevention of tuberculosis may be achieved by isolating the sick as far as possible, in improving housing conditions, improving the diet of the people and doing away with habits which encourage the onset and spread of the disease.

For the cure of the disease a complete organization is being brought into being. A central institution for research and control is essential. Tuberculosis clinics

should be available in all large towns, one would seem to be necessary for every one hundred thousand of the population. A clinic should contain a waiting-room for men, a waiting-room for women and children with an entrance suitable for purdah cases. A room for examination, X-ray examination and treatment, a room for artificial pneumo-thorax treatment, with a rest-room attached, and a dispensary. A plan is given at the end of these notes after page 90.

The clinic should be staffed by a specialist in tuberculosis, with at least one assistant, a dispenser and the requisite menial staff. A part time electrician is useful, and finally and most important a staff of nurses in proportion to the attendance.

The clinic must also give regular and expert advice to out-patients who require treatment in their own homes. Nurses from the clinic must visit these patients at home, seeing that they keep records of temperature, attend at the clinic when possible and carry out the advice of the specialist. These visits are of the utmost importance. The nurse will be able to co-operate with the family doctor if one is in charge, advise on diet, ventilation, isolation and the like, and will get to know the family and encourage other early or doubtful cases to come to the clinic for diagnosis and advice. The early treatment of infected contacts is most hopeful and valuable in controlling the disease.

At the clinic cases requiring institutional treatment should be advised where to go and their admission arranged.

The organization should include a hospital close to the town, for those who prefer to remain near their relations, or are in the doctor's opinion more suitable for that hospital. Other institutions are the tuberculosis sanatorium and a convalescent colony.

Cases can be admitted to the sanatorium from the clinic and the doctor will decide which cases are suitable.

There is some difference of opinion in this matter. Some authorities consider a sanatorium should preserve a cheerful and hopeful outlook and for this reason be reserved for cases in which the chance of recovery is definitely good. Others maintain that even advanced and very serious cases should not be debarred from the benefits of the sanatorium. It is certainly true that wonderful successes are obtained in even desperate cases. It may be said that the desirable atmosphere of the sanatorium can be preserved even while advanced cases are being given all the advantages of the latest and most successful forms of treatment. The selection however is a matter that must depend on the accommodation available and the policy determined by the committee in charge.

In the city tuberculosis hospital, and the sanatorium, provision must be made for all approved forms of modern treatment including X-rays, and a well-equipped operating theatre and pathological laboratory.

A considerable proportion of the sanatorium will consist of wards of about twelve free beds for patients. For paying patients and for special cases single and double wards must be provided in sufficient number.

Adjacent to the sanatorium it is wise to have plots of land to let on long leases to those who prefer to build private accommodation for a patient and his family. Such houses must be built on plans approved by the superintendent of the sanatorium.

Convalescent colonies are intended for those recovered from the disease, but not yet strong enough to return to normal employment. The idea is excellent but it remains to be seen how far such institutions will be appreciated by Indian patients. Where a colony has not been established, occupational therapy should be available at the sanatorium for convalescents.

Tuberculosis is highly infectious and should be a notifiable disease. Houses vacated by patients should be thoroughly disinfected.

Leprosy

Leprosy is wide-spread in India. It is far commoner than is indicated in census returns, and there is wide variation in incidence. In some areas it is not common, but in areas where living conditions are very poor, as in parts of the Central Provinces, a considerable proportion of the population suffers from leprosy.

The disease is caused by a microbe that is very similar to the tubercle bacillus. It is not hereditary, as some have maintained, but is spread by contagion. Close contact over a long period seems necessary for infection which as a rule occurs at an early age.

In many countries leprosy has been considered a punishment for sin, and lepers do all they can to hide a disease which gives them a sense of shame. This superstition needs to be vigorously combated. It leads to concealment of the disease in the early stages when it is highly infectious, but amenable to arrest, and even cure. The interval between infection and the appearance of the disease is long and definite signs may not be noticed for many months or even for two or three years.

Infection can be conveyed from nasal discharges direct to one using the same bed and pillow, and from open sores. The long period between transmission and onset makes it particularly difficult to trace the source of infection; but what is obvious is that close contact with a leper, particularly in childhood and when living under primitive conditions, is likely to lead to infection.

Like tuberculosis, leprosy is definitely a house infection. Apart from improvement in nutrition and general sanitation, better housing conditions will necessarily have a marked effect in preventing leprosy. Under-nourishment is also almost certainly an important factor.

It is obvious that a reasonable isolation of the leper and his belongings from the rest of the family, thorough disinfection of the house and early removal of children

from leper parents, will do much to lessen the chances of infection.

Compulsory segregation of lepers would increase the tendency already mentioned to conceal the disease and such a policy would defeat its object.

Voluntary admission to leper hospitals for early and infectious cases is fully appreciated. The demand however for admission to well-organized hospitals is so great, and the course of treatment so long, that the existing institutions have to refuse applicants every day for want of accommodation.

In close collaboration with the leper hospital every District should have several treatment centres, from which early cases are recommended for admission to the hospital and treated until a vacancy can be secured. The treatment centres should also treat all cases of leprosy regularly, whether seeking admission or not, and keep under observation the cases discharged from the hospital as 'symptom free' or 'disease arrested'. Every branch dispensary should devote a few hours at least once a week to the special examination and treatment of lepers, and this implies that every Assistant Surgeon or Sub-Assistant Surgeon, or other doctor in charge of a dispensary, should go through a thorough course at the Leper Hospital in the diagnosis and treatment of leprosy.

Dispensaries and any other hospitals undertaking the treatment of leprosy should be provided, at the cost of the leper hospital, with the special drugs now used so successfully. Local authorities would be well advised to allow the specialist from the leper hospital to inspect and encourage the work at all treatment centres working in co-operation, even when the leper hospital is not a Government institution.

The leper hospital should be a large central institution for the prolonged treatment of selected early cases, offering a real hope of rendering these patients free of symptoms and no longer infectious. In addition to the treatment centres and clinics there should be sufficient

leper homes where chronic and 'worn out' cases, incapable or unsuitable for employment, are given free accommodation and diet, and prevented from street begging or working in occupations where they are a danger to the public.

All this opens up the question of organized charity, so poorly supported, versus the promiscuous encouragement of street beggars that is far too common. Leper Homes and Poor Houses need not only financial support but close supervision. Three hundred blind paupers and lepers were used by a *daroga* (overseer) to beg at all the favourable pitches in Benares. The takings were shared and the *daroga* retired with a considerable fortune.

If it is possible to organize a complete campaign to control leprosy it is necessary to arrange a combination of survey, propaganda and treatment. Such a campaign was undertaken in the Central Provinces with the advice and assistance of The British Empire Leprosy Relief Association. In short the scheme consists of sending a party of five doctors trained in the treatment of leprosy to a given area of suitable size. The doctors survey the area meticulously, recording all lepers. By lectures, talks and other forms of propaganda all lepers are induced to attend weekly at a clinic opened at a convenient centre. When the survey is complete and the benefits of the clinic appreciated one of the doctors remains at the clinic and continues the treatment permanently. The party then recruits another doctor and moves on to the next area selected for the campaign. Often local doctors can be found able and willing to assist in the survey and propaganda and to remain in charge of the clinic. This is an advantage in many ways and reduces the number of doctors specially recruited for the work.

Such a campaign is likely to produce good results especially when combined with the activities of a central leper hospital, a number of treatment centres and sufficient leper homes.

A leper hospital must have private accommodation

for paying patients. The rich are particularly prone to conceal the disease and must have every encouragement to accept the long course of treatment that will enable them to return to their homes no longer suffering from a progressive disease, and no longer a danger to their families.

Leprosy is not a fatal disease and the death-rate among lepers is hardly higher than for the general population. Untreated lepers remain infective and at present there is nothing, not even public opinion, to prevent their mixing freely with their families and the public. Many years of organized effort will be required to effectively reduce the prevalence of leprosy. Improvement in general public health activities, better nourishment and better housing are essential for success.

Yaws

Yaws or framboesia has been well known in Africa and Australia among aboriginal tribes. It has a strong family likeness to a form of extra-genital syphilis described as common amongst nomadic tribes in Palestine and Arabia.

The disease is caused by a parasite very similar to that which causes syphilis and is cured by the same medicinal treatment, but is in no sense a venereal disease. Yaws has only recently been discovered and recorded in South India and is now known to be prevalent among aboriginal tribes living in the deep jungles extending from Bastar State, in the Central Provinces, southwards through the Eastern parts of the Hyderabad dominions.

The disease is common among a group of tribes known as Koyas and is known locally as 'Koya rogun'. There is little doubt that infection is by direct contagion and no insect carrier has been incriminated. The people affected are usually primitive and semi-starved, living on tuberous roots, scanty supplies of grain, honey and 'toddy' which they distil themselves. They are fond of meat when they can trap deer, pig or monkeys.

The disease is characterized by stages as in syphilis. The primary sore is situated in any part of the body at the site of infection and it is not uncommon on the shoulder of a man, or on the breast or hip of a woman, from nursing or carrying infected children.

Fever with pains in the bones and joints is present at this stage. The secondary symptoms appear after some weeks, a rash described as urticarial and accompanied by itching appears, followed by papules. The papules readily break down forming ulcers with crusts (rupia). On moist areas, and on mucous membrane, crusts do not form. Here the papules break down leaving the red irregular base of an ulcer exposed. It is from these ulcers that infection occurs and it is from their appearance that the name framboesia (raspberry) is derived.

A proportion only of these cases develop into the tertiary stage. In the tertiary stage there is deep ulceration, even extending into the bones of the head or limbs. There is distortion of the bones leading to crippling. Deformities, marked wasting and swollen distorted fingers are common complications, the whole making a miserable but typical picture.

Travelling with a small mobile dispensary a good Assistant Surgeon, who can win the confidence of these shy nomads, can work miracles if he is provided with the necessary drugs and syringes. In all but the most severe cases, symptoms disappear after even one dose of Salvarsan or similar preparations. Blood tests suggest at least four injections should be given at weekly intervals, and the patients instructed to apply at once for a further course if symptoms reappear.

This very short description of yaws is given as cases may come under the notice of officials and others in jungle country. It is practically useless to advise the primitive, jungle people to come into the nearest hospital, but it is well worth while to arrange for a mobile dispensary.

Hookworm (*Ancylostomiasis*)

In parts of India hookworm is common enough to cause definite racial degeneration, and steps for its eradication are essential.

The disease is characterized by progressive anaemia and debility of a severe grade, and these effects are naturally aggravated in a population living on a poor and unbalanced diet. Doctors with tropical experience will never neglect the possibility of other serious diseases in India being complicated by the presence of hookworm.

The hook-worm in man thrives in the upper parts of the small intestine and may be present in large numbers. It is a small worm less than one inch in length, and attaches itself to the mucous membrane. It lives on the blood and poisons the system. The female worm produces an enormous quantity of eggs which are passed with the faeces. Finding these eggs is the obvious method of confirming the diagnosis.

The cure of patients is a matter for doctors and dispensaries, but all interested in village improvement can initiate or assist in an organized campaign of prevention.

The egg develops into an embryo which can exist for months in mud or muddy water, or even in damp earth, until it gets an opportunity of penetrating the skin of a new patient. In Indian conditions this penetration generally, though not always, takes place through the bare feet of people frequenting the soiled surroundings of the village latrine or other area infected with faecal matter.

The route by which the embryos travel from the skin to their resting place in the small intestine is of great interest but does not concern us in our preventive work. The important point is that any moist ground near a latrine or elsewhere becomes dangerously infective when soiled by sufferers from hookworm, and the area remains infective for a considerable time. Steps must

be taken to prevent the development of the embryo worms. Latrines, well constructed and properly supervised, must be provided. Particular attention must be paid to keeping the surroundings of the latrine dry and clean. The 'aqua-privy' latrine described on pages 78-82 reduces the chances of infection to a minimum and is to be strongly recommended.

If it is considered essential to conserve faecal matter as manure, the trench latrine or bucket latrine can be adopted, and the faecal matter matured in shallow trenches or by the excellent 'Indore system'. If either of these methods is adopted the strictest precautions are necessary to make the latrine and trench surroundings unsuitable for the development of hook-worm embryos.

It is probably safer to have no latrines, and allow promiscuous deposition in dry areas round the village, rather than perpetuate the kind of latrine so often seen in villages and small towns, where there are no buckets and the floor of the latrine is disgustingly soiled with faecal matter and spilled water, and where the surrounding ground is foul and moist.

Those who desire to help villagers to protect themselves from hookworm must investigate and aim to perfect all details of latrines, conservancy and disposal.

While every effort is being made to prevent the development of embryos it is obvious that the other important weapon for defence is to cure those who harbour hookworms and are not only ill and debilitated, but a constant source of infection to their neighbours.

There are many drugs that have the power, in varying degrees, of destroying the hookworm in the human intestine. Some of these drugs have quite definite toxic effects and generally it may be said that the more efficacious the drug the greater care is required in its administration. Mass treatment of a tea-garden, an industrial or mining settlement, should be comparatively simple under expert medical supervision. In villages mass treatment can only be carried out with the

close co-operation of the health authorities and the people.

Where hookworm is known to exist, and mass treatment cannot be undertaken, every effort included in the term 'propaganda' should be made to encourage all those with even early symptoms of debility to seek treatment from the local or travelling dispensary.

Chapter IV

PERSONAL PROTECTION FROM DISEASE

Requests for advice are often made by those going for the first time to tropical countries. The following notes are the result of long experience, and while some of the suggestions are of a simple, even an elementary nature, they are none the less important.

(a) No one should go to a tropical country without being inoculated with T.A.B. against the enteric group of diseases.

The same inoculation should be repeated at two-year intervals, until an experienced doctor advises that circumstances permit some relaxation.

(b) No one should go to a tropical country without being revaccinated against smallpox, and this should be repeated at once if smallpox is in the neighbourhood. It is well to remember that many Indians, for fear of offending the goddess Mata Devi, do not seek medical advice for smallpox. Quite unknown to the employer the washerman's child may have smallpox in the quarters used for the family laundry.

(c) In a great part of India plague recurs every cold weather. In such places it is essential that one is inoculated against plague every year. This is best in August or September, and if done on a Saturday evening work need not be interrupted. One day in bed on light diet, and no alcohol, does much to mitigate the objectionable reaction.

(d) Whenever cholera occurs inoculation should be sought at once. Immunity is rapidly produced and is effective for several months.

To neglect these four simple precautions is to invite tragedy. Do not believe anyone, even a medical man,

who warns you to postpone inoculation during an epidemic for fear of the effects of a so-called 'negative phase', during which those inoculated are said to be more liable to infection. There is nothing but misapplied theory in such advice. The practical fact is that inoculation against plague and cholera during an epidemic is very necessary, and is free from danger.

Water

We have examined some of the diseases caused by water. Too much stress cannot be laid on the absolute necessity of abstaining from any water of doubtful origin until it has been rendered harmless by boiling and cooling in clean vessels, or by efficient filtering.

Wherever a properly constructed and efficiently controlled pipe-water system is not available water should not be drunk until it has been boiled. It is easy to establish a regular routine in any properly conducted household. The water for the day should be boiled in a large special vessel in the morning, and set apart for drinking purposes in clean jugs, with muslin covers. When the water has any sediment or foreign matter this can be removed by filtering through muslin before boiling.

If it is decided to trust to a filter, great care is necessary to ensure that the filter is of an efficient type, that it is in good mechanical order and scrupulously clean. The only efficient filter is the candle type. This may be an earthenware vessel with several 'candles', the water filtering through the candles, by gravity, into a lower compartment fitted with a tap. Another form is a pump filter which forces the water through a small metal cylinder containing a porous candle. The force may be derived from an ordinary pump mechanism, by hand power or direct from the main by screwing a filter on to a water tap having a sufficient head of pressure.

In any case the filter must be constantly inspected and all junctions and washers seen to be in good order

and clean, ensuring that the water does actually pass through the fine pores of the candle, and does not leak through metal and rubber junctions.

The candle is made of a special porous material of so fine a texture that even minute bacteria cannot penetrate. After a period of use, which will vary with the impurities in the water, the candle becomes coated with a gelatinous mass of arrested material including infectious bacilli. This gelatinous mass blocks the pores and makes pumping difficult. It must be removed without infecting the parts of the filter ordinarily occupied by the filtered water. The candles should be gently detached and at once dipped in water actually boiling. This is necessary to destroy any infectious material. The mass rendered innocuous by the boiling can then be gently removed from the candle with a soft brush. The candle is then rinsed in clean water and efficiently replaced. Candles are easily cracked and must be handled with care. A cracked candle must be discarded as dangerous. Special care is necessary to restore all junctions as completely watertight, and the whole filter washed out to remove traces of impurity introduced by handling.

On a journey one does not always wish to wait for drinking water to boil and cool, and the carriage of large quantities of drinking water is seldom easy. For camp use and while travelling by road or on a railway, a small pump filter known as the Berkefeld is very convenient.

Before leaving the subject of filters a warning is necessary against inefficient filters. The Indian habit of filtering water through two superimposed *garas* (unglazed earthenware pots) into a third, all three supported in a wooden stand, is dangerous, and not to be recommended. The two upper *garas* have a small hole filled with a wick of cotton through which the water dribbles. The resulting water is temptingly cool and free of gross impurity, but dangerous organisms, if present in the original water, will appear in the filtrate, with the exception of the cyclops. This method however is

better than none and valuable in places where guinea worm is common.

The other type of filter is the glass cone containing a block of charcoal over a glass jug. This too will keep out gross impurities but bacteria (cholera for instance) will breed and increase in the wide pores of the charcoal, and the filtrate may be more dangerous than the original water.

In the old days vast sums were spent in moving troops out of barracks into camps to get away from cholera. In those days the cause of cholera was unknown and the charcoal filters, conscientiously taken for the use of the men, continued to spread the disease it was hoped to avoid.

Swimming baths are a frequent cause of illness. Septic sore throats, sometimes with serious complications, have been caused by the polluted water. Serious water-borne diseases may be spread by the swimming bath. With proper precautions the danger can be removed. The water should be changed as frequently as circumstances permit, and every day, bags of copper sulphate strung on a rope, should be passed through the water. A very small amount of copper sulphate will destroy harmful organisms and it is quite unobjectionable in quantities permitted under the advice of a doctor. One part of copper sulphate in two million parts of water is sufficient.

Milk

A supply of good milk is absolutely necessary for health and milk is liable to direct contamination by flies, from imperfectly cleaned vessels and by the addition of polluted water. The Indian milkman looks upon dilution as a normal procedure, and unfortunately the water he uses is that readiest to his hand, and generally polluted. Milkmen in India have been known to contrive to dilute the milk even in institutions where milking is done under supervision.

Unless certified milk is available from an organized dairy under government or municipal control, it is probably wisest to keep a cow and have it fed and milked under strict supervision. It is important that cows kept for milking purposes should be well and cleanly fed. Among the bad practices prevalent in India is the one of feeding cows on stable litter.

In the actual milking the man's hands and the cow's udder should be washed before milking, with a weak solution of permanganate of potash, and the first two ounces of milk should be wasted on the ground and not drawn in the pail or *lota*.

There is no great objection to humouring the Indian practice of having the calf present to encourage the cow to yield her milk, even if the calf is only represented by its skin stuffed with straw. If the calf is alive its desire for the milk must be checked.

The vessels used for milking, and for storing the milk must be filled with water after ordinary cleaning, and the water boiled and left in the vessel to be thrown out only when the milk is to replace it. The vessels containing milk must be covered to keep out flies. Perhaps the best type of vessel for storing milk is an aluminium cooking pot with a well fitting cover.

When milk is required in camp, or where all precautions cannot be taken, it should be boiled and set apart in a covered vessel to cool. This may be the only precaution possible under some conditions, and is necessary and safe. For young children, unboiled milk, provided it is safe from pollution, has advantages over boiled milk.

Buffalo's milk is considerably rich in cream and protein but few British people prefer it to cow's milk. The precautionary measures to be taken are the same.

If goat's milk is used it is always safer to boil it, as fevers of the Malta Fever type are more likely to be spread by goats than by cows or buffaloes.

Condensed milk of good quality is useful as a

standby in an emergency, and is excellent in illness where cow's milk is not well tolerated or is of doubtful purity.

Dried powdered milk, or dried powdered skimmed milk, is useful for issue to schools, or during epidemics, where good cow's milk cannot be obtained or is too expensive. School children given a ration of milk made of diluted skimmed-milk powder rapidly show an increase of weight, but for Infant Welfare Centres the powder has not proved satisfactory.

Finally any milk used for domestic purposes or for general issue must be treated with due precautions and with all the care recommended for drinking water.

In discussing cholera it was suggested that raw fruit is dangerous and during epidemics should be avoided. Fruit and vegetables including lettuce, as sold in India, are often soiled and should not be eaten raw until they have been washed. A very simple and safe procedure is to wash all fruit and salads in a weak solution of permanganate of potassium. It in no way damages the fruit or affects its flavour and this procedure should be a part of the household routine.

Cooking pots require special attention. Dirty pots are the cause of indigestion and even acute gastro-intestinal disease.

There is no foundation for the theory that aluminium cooking pots are dangerous, but like others they need to be scrupulously clean. If copper pots are used they must be properly tinned by the *kalaigar*. Spots of exposed copper are dangerous. Every pot in the kitchen and all milk vessels, after cleaning, should be exposed in direct sunlight on a clean board for a routine inspection when stores are being issued and the day's orders given.

Clothing

Tailors always try to persuade those going to India to take only thin light clothing. In many parts of India the temperature may be quite low and in other parts journeys through snow create a need for warm clothing.

Nearly everyone will visit the hills at some time and it is wise to take to India all the warm clothing usually required in Great Britain, as well as thin clothes suitable for the heat. A covering, even if it is only a towel, should be worn round the waist, even in the hot weather, when sleeping.

A good sun-hat or solar *topee* is essential and this should be especially thick for long marches, or shooting in the open plains. For such purposes the protection should be augmented by a 'back-pad' to protect the spine.

The sun is dangerous in India and the desire for sun bathing should be curbed. On tropical voyages and in the tropics sun bathing is not beneficial and may be harmful.

Exercise

Reasonable exercise is valuable in any situation. Often the tendency in India is to take excessive exercise. A game of tennis, or a ride or other form of exercise as a relaxation is definitely beneficial. To ride in the early morning, play tennis in the afternoon, followed by a swim, and then to dance at night, is to wear out resistance to illness and to waste the energy required for useful work in a trying climate. Exercise should be taken in the fresh air.

General

Even the most trivial injuries which break the skin should be treated with respect in the tropics. Poisonous organisms may cause inconvenience and even dangerous illness. The immediate application of iodine, or undiluted dettol, and a clean dressing will prevent infection. Abrasions infected from contact with horses and their stables should be carefully treated as they are likely to set up tetanus.

Malaria is so common and so universal that precautions to protect oneself from mosquitoes are essential for health and necessary for comfort.

The well-organized household will provide mosquito

nets for all beds. It is unwise to sleep without a net unless an efficient electric fan or punkah can be trusted to keep away flying insects.

During the working hours of the day mosquitoes are not very active, and during the night one is safe under a net. It is in the evening, sitting out-of-doors, that the danger of being bitten is greatest. This danger can be reduced by rubbing citronella on the exposed skin, by wearing special mosquito boots or by using a fan. In the early autumn and in places known to be malarious it is best to do without these pleasant evenings in the garden.

A mosquito-proof house can be constructed but in India there are practical difficulties and landlords do not hold themselves responsible for providing protection in this respect.

The methods of destroying mosquito larvae have been described in considerable detail in Chapter I. All such precautions as are applicable should be taken with systematic regularity in the garden and the whole 'compound'. Such measures will add much to one's comfort as well as providing protection from malaria.

Culex mosquitoes breed inside as well as outside the house, in any standing water. The saucers of water placed below the feet of food-store cupboards is a favourite breeding ground, and these saucers, intended to keep away ants, must be emptied once a week or they will produce an annoying number of mosquitoes.

When working or shooting in jungle country it is well to take five grains of quinine in solution daily, or perhaps better ten grains every second day. This precaution is particularly necessary in the autumn just after the rains, a season when it is well to avoid shooting trips.

Children

A final word about British children in India. The tendency of home trained 'Nannies' is to get the children

out early in the morning, before the sun has any great warmth, and to keep them indoors until the sun has set or is setting.

Sunlight is necessary for the perfect development of children. It is an advantage to postpone the morning walk until the beneficial rays of the sun are available. The child must of course be protected from the full heat of the sun by a suitable hat or other shield and must not play in full sunlight during the middle of the day.

A great part of the day should be spent in a not too shady verandah, but no infant should be allowed to rest in a cot or pram looking up into the strongly illuminated sky.

Do not forget that children in the hot weather are thirsty and require water. Even infants require water in addition to their milk.

All these instructions are really quite simple, and good Indian servants readily learn to fit all these precautions into the regular routine of the household.

CHAPTER V

PUBLIC HEALTH

Economics of Public Health

THE object of this short note is to demonstrate that public money granted for sound schemes of public health is well spent. The primary object is a definite improvement in the health of the people and in their social conditions, with consequent physical and mental well-being and general economic prosperity. Not only is all this secured but money so spent is a good investment, showing returns that have a direct or indirect money value.

How the public money for this purpose should be collected, and how grants should be made, are problems beyond the scope of these notes. Grants from the Central Government to provinces, and from provincial to local bodies, should ensure uniformity and should necessitate at least a minimum standard of service.

The provision of considerable funds for curative medicine is rightly accepted as necessary and has a definite appeal. It requires no very deep thought to realize that the provision of larger sums to be expended in successfully preventing disease, in improving social conditions and increasing industrial efficiency is even more necessary and more logical.

Simple examples of the economic value of public health expenditure are probably more convincing than arguments.

In Hyderabad City the Plague Department was developed on scientific lines in 1930 and the average cost for the next nine years was Rs.90,000.

Each year it was computed that five million rats were destroyed, and it is a moderate estimate that one

rat caused damage valued at three rupees a year by undermining houses, destroying material and consuming grain and other food. The elimination of millions of these agents of destruction necessarily implies the saving of millions of rupees.

Before the plague campaign the grain markets had been closed for several months every year on account of plague, and these grain markets are the mainstay of the city. During the nine years of the campaign the markets were not closed for even one day. The deaths from plague were reduced from a yearly average of many thousands to one or two hundreds, and it should be noted that the lives endangered by plague are for the most part those of young working men and women.

In the same city, and for the same period, a well-organized campaign against malaria was conducted at an average yearly cost of Rs.45,000. In one area of the city, when the campaign opened there were only two or three derelict houses, forsaken as unhealthy on account of malaria. Land in that area was selling at Rs.30 an acre. Within a few years malaria had been eradicated, more than a hundred prosperous suburban villas had been built, occupied by a thriving population, and land was selling at Rs.5 a yard.

In another area, the spleen-rate had fallen from 87 per cent to 0.8 per cent and the general death-rate in the city had fallen from 36 to 18 per thousand. Surely these figures fully justify the expenditure incurred.

In one small town a model slaughter house and model vegetable and meat markets were built. The rents obtained paid five per cent on the capital outlay in the first year.

The building of model houses in place of slums, particularly for the housing of the industrial classes, is a paying proposition and an urgent necessity.

The provision of water-works and drainage schemes is always followed by increased prosperity, as well as better health. In fact there is no well-devised scheme

for improving public health that is not a sound financial proposition.

In Great Britain it was decided long ago that public health activities have a claim to be fully met. Local authorities are encouraged to invest capital, or to borrow, in generous amounts to meet expenditure on water supplies, and the drainage schemes that are implicit in a free supply of water, in nourishment for children and mothers, and in the prevention of disease.

Responsibility is recognized. Not only are large sums invested in these precautionary measures, but local authorities have been mulcted in large sums which are then paid as compensation to individuals infected with preventible diseases.

Comparison between Great Britain and India is perhaps invidious and cannot always be held to be applicable or completely convincing, but the point worthy of note is that local authority is expected to grant all reasonable sums for the protection of the public, and are penalized if they fail in this duty. A more generous attitude in these matters is very desirable in India. Water and drainage schemes, the nutrition of children and mothers, and the prevention of disease, call with complete justification for larger expenditure. All the wonderful work of the research laboratories should be given practical application.

Nutrition

Sir Robert McCarrison has written a most excellent small book entitled *Food*. It is necessary that all interested in Indian welfare should read that book, and recommend its use in schools, colleges and all welfare organizations.

Sir Robert gives an example of a well-balanced diet as used by certain races in Northern India. This diet amounts to 57 ounces a day containing roughly 90 grammes of protein, 90 grammes of fats and 436 grammes of carbohydrates. The diet gives 2,900 calories and its

efficacy is shown by the well-developed and virile individuals of those races. The second example given is the diet of a poor Hindu family amounting to only 22 ounces a day containing 43 grammes of protein, 7 grammes of fats and 520 grammes of carbohydrates, giving in all 2,300 calories. To quote the text:

> This diet contains too little protein, all of which is of vegetable origin, far too little fat, too much carbohydrate and not enough calories. It is dangerously low in all the vitamins, especially A and B and it is deficient in salts, notably of calcium, phosphorous and iron. The family living on this diet will have low vitality, be incapable of sustained hard work and will be prone to bowel complaints.

The third example is of a well-to-do Hindu family which is summed up as follows:

> This diet is too poor in animal protein and animal fat, too rich in carbohydrate, and too high in calories. It should be adjusted by reducing the amount of rice eaten, by substituting unpolished for polished rice and by increasing the amount of milk, milk-products, green leafy vegetables and fruit.

Nutritional errors vary in different localities and in different classes. It is necessary that every Provincial Government, and every large Indian State, should employ a trained expert in nutrition who should be provided with a sufficient staff to conduct surveys in the field and experiments in the laboratory. The officer in charge of nutrition must be one who knows and is sympathetic with Indian habits and Indian prejudices. Recommendations made on merely theoretical grounds may be quite unacceptable to the people.

At the best, general acceptance of dietetic suggestions must be a matter of time, education and propaganda, meanwhile much good can be done in schools and other institutions, particularly institutions for the care of the young.

Milk issues in schools are absolutely necessary for the poorer pupils. Even the very cheap skimmed-milk powder confers immediate improvement. Milk issues have a permanent effect in that the well-nourished child becomes lusty and strong and develops on normal lines.

More milk, more green vegetables and more fruit are very generally required, and if meat is forbidden the proteins must be made up as far as possible with milk, eggs, wheat flour and potatoes, or root vegetables, as well as the standard *dhal*.

Sir Robert McCarrison states that nutrition is the most pressing of all present-day problems in India. It is certainly true that work on village sanitation, the control of epidemics and education will be vitiated unless the villager is put in a position to increase and improve his diet.

Vital Statistics

In many villages in India there is still grave inefficiency in recording births and deaths, and dangerous delay in reporting outbreaks of epidemic diseases. The system varies in different provinces and between towns and villages. It is said that particular attention has been given to ensuring accuracy in some provinces and in some cities but it cannot be denied that over wide areas the returns are incomplete and inaccurate.

In villages the official responsible for these reports is the village watchman often called the patel or police patel. He holds his position by hereditary right and is often unequal to his heavy responsibilities. Above all he is underpaid. He requires more education, better training and more supervision.

Many births and deaths are not recorded at all, and the cause of death is given as 'fever' in most cases that are recorded. Accurate returns of births and deaths are of real value, and are necessary in framing a sound public health policy. Everyone actively employed in measures to arrest disease realizes that the importance of

immediate report of outbreaks cannot be expressed too strongly. It requires no deep knowledge of cholera, plague or smallpox to realize how easily an epidemic can be prevented if the first cases are immediately reported, and how difficult these outbreaks are to arrest when they have been allowed to spread from village to village.

Until public health authorities insist that the patel is properly trained, properly paid and properly supervised, the fight against epidemic disease is handicapped and a large preventible death-rate will continue to impoverish the country.

Maternity and Child Welfare

In several of the large cities in India much attention has been given to the upbringing and nourishment of infants, and to improving the conditions under which children are born. The suggestions made here are not intended to influence any system that has developed on lines similar to those in other civilized centres of population, and which is proving efficient. The system outlined here is applicable to a great number of towns and villages throughout the country where only tentative efforts have been made to deal with the tragic maternal and infantile mortality. Most of this mortality and suffering is definitely preventible.

The material at hand includes, in practically every District a woman's hospital staffed by women doctors, with all facilities for complicated midwifery and one or more wards for children. There are also a number of trained, untrained and hereditary *dais* or midwives, and in some Districts perhaps an additional ward in the District hospital for children. A successful scheme must make full use of the wards for women and children and particularly of the women doctors available. It is necessary and also good policy to make use of the local *dais,* to encourage them to accept training and help

them, when trained, to obtain practice and a livelihood. If the local *dais* are antagonized the development of useful work will be delayed and hindered.

Experience suggests that in most parts of India an Infant Welfare Centre should combine an ante-natal clinic, maternity work, maternity training, and the practical care of children with instruction in mother-craft. From the Infant Welfare Centre trained local *dais* are sent out to conduct normal maternity cases, and their work is constantly supervised.

The whole Centre should be under the control of a highly trained nurse who has qualified as a midwife and has had a full course at a recognized school of training in Infant Welfare. She must visit the homes of the people in the area and should be assisted in her work by two well-trained ayahs and the necessary menial staff. She is usually known as the Health Visitor. She should live on the premises at all times to be easily available.

A simple plan for an Infant Welfare Centre is given after page 90. The wide north-verandah is a valuable playroom and should face a flower garden. The two rooms and bathroom to the East are the head nurse's residence.

The work of the Centre must be supervised by the Public Health Officer, assisted by a visiting committee of ladies, of which at least one member should be a woman doctor from the nearest women's hospital.

The duties of the health visitor are to be present during visiting hours when mothers and children are admitted. The hours should be not less than four on six days of each week, but will vary with the season and the convenience of the public. The Health Visitor should see each child, order the weight to be recorded and, where necessary, extra milk diet or clothing issued. She should see that the children are bathed regularly and slight ailments treated with home remedies. Illness requiring more than simple home treatment should be

referred to the hospital or private practitioner, the mother being given a recommendation card.

Classes for the mothers can be arranged, at which instruction is given in the proper clothing for children, including lessons in sewing; the nourishment of children, including cooking, together with talks on general domestic problems. From time to time a woman doctor or health officer should give a special lantern lecture on preventible diseases.

Regular classes and practical demonstrations for *dais* should be given by the health visitor, the course to consist of twenty-five lectures spread over not less than six months. The pupils should as far as possible be recruited from the indigenous *dais*, a small reward paid for each class attended and a certificate of efficiency given after passing an examination conducted by a woman doctor. Refresher classes are necessary. Twenty *dais* is the maximum number that should be kept on the books of the Centre, as the work of more than twenty cannot be satisfactorily inspected. Every case being conducted by a *dai* from the Centre should also be visited by the health visitor. These visits should continue until the case is out of danger.

The area served by the Centre should not be too large. No case more than a mile from the Centre can be accepted. In a thickly populated city this must be reduced to half a mile.

Once a *dai* is certified as efficient to conduct normal labour cases the Centre will, through the ante-natal clinics and otherwise, endeavour to get her cases, and will provide her with a fresh sterilized outfit for every case. The *dai* should always return the soiled outfit and be paid a small fee for each birth reported. The *dais* are trained first of all to be surgically clean, and secondly to be quick to recognize conditions or complications that are beyond their skill. The prompt report to the Health Visitor of any complicated case which is justified and beneficial should be rewarded.

The ante-natal clinic should be conducted in the Centre by a woman doctor assisted by the health visitor. One afternoon a week is usually sufficient.

Under the scheme roughly outlined the expectant mother is seen and safeguarded and the confinement is conducted. The mother and child are kept under close observation during the early and anxious days, and she is encouraged to attend the Centre later with the child. Here she receives further instruction and advice and the child comes under expert observation. As the child gets older he should join a 'toddlers class', for the medical supervision will then be continuous, and link up with the medical inspection he will receive later at the primary school.

The training of midwives at the Infant Welfare Centre for work to be done under close supervision of the health visitor is the lowest standard of instruction that can be recognized. Training at maternity hospitals must be far more thorough and the course far more extended.

The question of training midwives and hospital nurses is beyond the scope of this book. It must be understood that the training at Infant Welfare Centres of indigenous *dais* in the vernacular is only the first step to meeting existing conditions in backward areas. There is reason to hope that with the spread of education and the development of a public conscience conditions will improve and more highly trained midwives will be available.

For many years to come the demand for medical personnel of all kinds will be so great that highly qualified men and women will not be available in sufficient numbers. The demand meanwhile has to be met by accepting medical assistants of a lower grade for certain situations where their work can be supervised. The standard of education in medical subjects at the Indian universities and large hospitals is very high, but the number of graduates is limited. Large numbers of

doctors, nurses, midwives and dispensers, whose education is limited to bare essentials, have to be employed.

Medical Inspection of Schools

It is the duty of the local authorities to make arrangements for the medical inspection of schools and school children.

Every child attending school should undergo a detailed medical examination within six months of admission, and at such intervals as may seem desirable, but each pupil must be examined at least once a year.

For each pupil a special card is filled in showing the date of examination and the condition of the eyes, ears, teeth, tonsils, important organs and skin. Physical development, weight, height and age are recorded. The examination card is kept by the schoolmaster, transferred to another school with the pupil, and always produced and completed at the time of medical inspection.

Any recommendation for medical treatment is entered on a special card to be sent to the parent. Any recommendation affecting the attendance at school will be entered on the examination card and initialled by the schoolmaster.

The school medical officer may find it necessary to exclude a child from school or to modify the hours of work or the form of recreation.

Early cases of leprosy and tuberculosis are to be excluded from ordinary classes until suitable treatment has made readmission possible.

The medical officer will also inspect the school premises and playground. He will record his views on the suitability of the buildings and whether there is any overcrowding or defect in ventilation. He will note the efficiency of the lighting and any possible cause of eye-strain, and report on the arrangements for physical exercises. He will also report on the cleanliness of the pupils and on lavatory and conservancy arrangements. Malnutrition is to be specially mentioned and extra milk

and diet ordered when necessary. In times of epidemics the school medical officer will decide whether and when the school should be closed.

The school medical officer should write an annual report calling attention to any prevalent diseases or physical defects among the pupils and anything unsuitable in the school premises. He should make definite recommendations for improvement. One copy of this report is sent to the local authorities and one copy to the Public Health Authority. Urgent medical recommendations must not be kept back for the annual report but should be made to the headmaster, or if necessary to higher authority, without loss of time.

Appliances for the medical examination, and supplies of stationery should be provided by the school.

Free medical and dental treatment will be provided for school children at the Government Hospital.

Extra diet, spectacles or surgical appliances recommended by the school medical officer should be paid for by the school in all cases where the headmaster certifies that the pupil is indigent.

Propaganda

It is obvious that the people of India sorely need information on many points. Public opinion will in time overcome prejudices and bad habits. This must be fostered by propaganda. The information givne must be within the grasp of the simplest, it must be interesting and it must be convincing.

Many methods are in use including posters, plain and coloured, booklets, lectures, gramophone talks and songs, magic lantern lectures and cinema shows.

Many of the existing posters and booklets dealing with tuberculosis, leprosy and malaria are excellent, but all these need amplification by informed talks. Those working to prevent or overcome epidemics, and in schemes of general improvement, should miss no opportunity for quiet and persuasive talks with the crowd so easily

collected in India. It is desirable to give the simplest explanation of the measures taken and the results that can be promised: never forgetting the importance of enlisting the co-operation of the people themselves.

While engaged in public health measures it is very necessary to avoid any word or action that may offend the susceptibilities of the people or militate against their social or religious prejudices. For example, purdah in a poor household is a real danger that must be left for time and education to remedy. In the meantime we can respect its conditions by always providing women workers for every grade, and doing what is possible to overcome the evils of the system.

The domiciliary visits of trained nurses has already been mentioned under tuberculosis. These visits are a great opportunity for propaganda, besides being of great value and importance in themselves.

Lantern lectures should be given in the streets in the evening. Excellent slides for these lectures are issued by the Red Cross Society. Suitable lectures should be given regularly in Infant Welfare Centres for the women, and in camps for boy scouts and girl guides, and also at all gatherings whenever possible.

If the lantern can be replaced by a cinema and loud speaker so much the better. In Hyderabad an interesting and very instructive film on plague was made. This is on a continual tour through the villages. A loud speaker announces the captions and gives a running commentary in the local language for the illiterate. In villages the people are not only interested but delighted. In one village where attempts to use anti-plague injections had failed, one night of cinema propaganda produced seven hundred recruits for inoculation next morning. A copy of this film is with the Red Cross Society which also has for circulation several interesting films on leprosy, malaria and other diseases.

Gatherings for wrestling bouts, athletics and games should very definitely be encouraged, and may well be

combined with 'baby weeks', flower shows, agricultural and other exhibitions.

Radio sets and wireless broadcasts are being introduced and while there are many difficulties, particularly as to language, broadcasts are steadily becoming real value as propaganda.

In forming public opinion education holds the first place. Those responsible for teaching, from the primary school to the university, must themselves be convinced of the national importance of public health measures, and should be induced to propagate general knowledge with conviction and enthusiasm.

Chapter VI

BUILDING REGULATIONS FOR SMALL TOWNS

General

1. No person should be allowed to erect any building, or alter or add to any existing building, without the sanction of the local authorities.

'Building' includes any hut, shed or other enclosure, whether used as a human dwelling or otherwise; also walls, verandah's, fixed platforms, plinths, doorsteps and the like.

2. No new building should be sanctioned on any site which interferes with the alignment of streets and surface drains, existing or proposed.

3. The height of new buildings on a street-frontage should be limited to the measurement of the width of the road.

4. Dwelling houses should have an open space behind the buildings, of the same width as the building, and measuring in depth (i.e. from front to back) not less than the height of the building. A latrine or a cookhouse of not more than 8 feet in height, may be allowed in this area.

5. The plinth of all dwelling houses, stores and shops should be

(i) Not less than 1½ feet in height for dwelling houses and 2 feet for stores, shops, etc.

(ii) Not within 3 feet of the actual road surface, including road-side drains.

(iii) Of solid construction with a floor surface of stone. Localities mainly inhabited by the labouring classes may be exempt from this sub-clause.

The plinth of all subsidiary buildings, kitchens, cattle sheds, stables and latrines should be sufficiently high,

not less than 1 foot, to allow of efficient drainage. This will not apply to garages for motor cars.

6. At least one side of every room should be provided with a window in an external wall, or a window opening on an interior courtyard. The surface measurement of the courtyard should not be less than the surface measurement, added together, of all the rooms which open only into the courtyard. Windows must be capable of being opened and should not measure less than one-tenth of the floor area of the room.

7. No room should be constructed less than 8 feet in height.

Ventilation openings should be provided near the ceiling in every room, allowing a free current of air. These openings may be protected by wire netting or expanded metal.

8. Private latrines should only be sanctioned

(i) If placed 10 feet from an existing or proposed street and at least 30 feet from any well.

(ii) If well ventilated.

(iii) If provided with stone or hard cement floors, constructed with a slope of 1 in 20 towards the sweepers' doors.

(iv) If reasonably screened from public view and readily accessible to the conservancy staff.

9. Arrangements for the disposal of sullage water should be approved, drains to be of impervious material with a fall sufficient to prevent stagnation. Collection must be into movable receptacles readily cleaned and not placed below the ground level. No cess-pits should be allowed.

10. All new grain godowns and stores must be constructed with a two-foot plinth and rat-proof floor. Each wall which contains a doorway is provided, at floor level, with a rat-proof ledge projecting nine inches horizontally. Only movable steps are permitted.

Markets and other Public Conveniences

Markets for meat and vegetables and slaughter houses are not required for small villages. Villagers go to the smaller market-towns regularly and the suggestions made in this chapter are mainly for the assistance of sanitary authorities in small market-towns. Enthusiasm for modern progress has in some small villages led to the construction of slaughter houses although the number of goats slaughtered did not average one a day. Such expenditure is a waste of public money, and in villages where money can be found it would be far better used in providing a playground for children, with swings, and horizontal and parallel bars. In Hyderabad an enormous number of villages and towns, have been supplied, at very small cost, with playgrounds, to the delight and benefit of the children. In towns where the playgrounds are on a larger scale it is advisable to provide a shelter from the sun and rain. A very handsome and inexpensive shelter can be designed with a roof supported by pillars, covering a paved floor. The western side may be closed by a wall which gives protection from the monsoon rains and the afternoon sun. Such a shelter is much appreciated in playtime and is also very useful for giving magic lantern or cinema lectures for propaganda purposes. In one town it was found that the poorer purdah ladies, having taken precautions to preserve privacy, made regular use of the shelter and playground at night, to their great enjoyment and to the benefit of their health. Where special gardens for purdah ladies cannot be provided, arrangements for women in the children playground should be made, and the whole area reserved, when the children have gone to bed, for the use of women.

The plans of vegetable, beef and mutton markets are given at the end of this book. A few points are worthy of consideration. Butchers will only pay rent for stalls with ready access from the entrance. The old pattern

of a long rectangular building with stalls on each side has the advantage of being simple to design and construct, but anyone with experience will appreciate the difficulty of persuading butchers to pay for stalls not close to the doorway. Multiple doorways might meet this objection but would enormously increase the difficulty of excluding flies. For this reason the mutton market has been designed as a semi-circle with every stall equidistant from the entrance. The beef market for obvious reasons does far less business than the mutton market and usually two or three stalls only are required, and these can be constructed in line.

All meat markets must be fly-proof and the entrance provided with two swing doors so that flies do not readily gain admission.

The floor of the stalls should be sloping for efficient drainage, and a water-tap provided in each stall for daily flushing.

Supervision is necessary to ensure flushing and general cleanliness and the exclusion of flies. It is generally necessary to discourage a tendency to prop swing doors open with stones or wedges.

The partitions between stalls should leave a clear space of three inches from the floor. This is necessary for efficient flushing of the stalls and to eliminate corners which are difficult to keep clean.

The front of the market should face the north and be mainly of fly-proof gauze admitting light and air, while the southern wall provided with ventilators keeps out the direct rays of the sun.

A cubicle for the sanitary sub-inspector and his implements should always be provided.

The design after page 90 covers all these requirements.

A separate room for the sale of second-class meat called the 'Boti Market' prevents the accumulation of unpleasant scraps in the general stalls.

The night storage room is found useful by butchers to store unsold meat during the night.

The chowkidar's room is a small room where the custodian keeps his brooms, etc., for cleaning.

A water-tank placed on the roof allows a tap to be provided in every stall.

All windows are fitted with good quality copper gauze. Cheap iron gauze is found unsatisfactory as it rapidly rusts and is easily broken. Angle-iron frames are preferable to woodwork.

The flooring throughout is of stone slabs on concrete.

Wooden blocks are allowed for cutting meat, but no meat almirahs are permitted.

The size of the building can of course be increased or reduced to suit local requirements.

The interior should be cement plastered to a height of 3 feet from the floor-level of the stalls with rounded corners. The rest should be lime plastered.

Slaughter houses in the smaller Indian towns often lack essential sanitary features in construction and are too often allowed to get into a horribly dirty condition.

The design after page 90 is a very simple design of an open yard, the floor sloping to a central drain. It is very cheap in construction, easy to keep clean and is appreciated by the butchers.

Four-sevenths of the yard is open and three-sevenths covered with a roof allowing of free ventilation. It is important that the roofed end of the enclosure is made to face the east and the rising sun. In the morning when slaughtering is done the whole area is shaded. Later when the work is finished, the meat removed and the floor and walls have been washed down, the afternoon sun cleanses and drys up the whole enclosure. No fly-proof gauze is necessary and none is provided. With reasonable cleanliness, and the free admission of sunlight, flies are not attracted to the enclosure. This has been proved by actual experience.

The floor and walls up to two feet must be constructed of first class masonry, preferably stone.

The tank provided allows of thorough daily washing

of the floor, and all washings fall directly into a cart which is removed to a distance for trenching. The platform for carts must be well paved and cleaned daily.

With reasonable daily cleanliness, and the removal of the cart regularly, these structures are found to remain quite free from flies. No fly-proof gauze is necessary and the large ventilators permit a free flow of air under the roofed portion.

The floor must be well constructed of two-inch stone slabs laid on concrete.

All corners should be rounded.

The pavement stone should be carried up the side walls to two feet.

The size of the structure can of course be varied to suit local requirements. Separate slaughter houses must be provided for sheep and for horned cattle.

Vegetables markets are more difficult to popularize. For generations the vegetable sellers have sat by the roadside with their produce exposed to every sort of pollution, and themselves exposed to the heat and the rain. The obvious advantages of protection will assist in securing compliance with reasonable market regulations.

The design given after page 90 has many advantages. It completely protects the produce and the vendor and, if constructed on a site acceptable to the people, will soon achieve popularity.

The stalls should be separated by partitions ending three inches above the level of the sloping stone or cement floor, as in meat markets. The whole floor space can then be thoroughly flushed and swept. A small and cool cupboard below each stall for storing vegetables is an advantage. This necessitates building the floor of the stall two and a half feet above the paved foot-path, and keeps the stalls free from dust.

No fly-proof gauze is required and the markets need no walls. The roof is supported on pillars, the eaves being brought low to exclude the sun and rain. In parts of India where the monsoon is strong, with driving rain,

a wall, instead of pillars, on the western side will be a useful protection.

Wells and Water-supply

The provision of a pure and ample water-supply is the most important function of Public Health Authorities in every country. The prevalence of diseases in India caused by pollution of water makes it imperative that pure water is provided in every community and that the supply is protected from contamination.

In important towns modern waterworks have been provided and safe distribution through suitable mains and pipes arranged, and the whole service is inspected regularly and controlled.

In almost all villages and in most small towns in India the public water-supply is from wells, and it is of vital importance that the source should be pure, and the well so constructed that the water is preserved from pollution.

There are few localities where the people fail to distinguish certain wells as containing 'sweet' water and special attention should be paid to public opinion in this matter. The popular wells should be the first improved and protected.

Wells known as 'deeps wells', that is, wells which tap springs in permeable strata below a stratum of impermeable formation, are safe from seepage, give better supplies and are in every way to be preferred to 'shallow wells'. The latter are excavated from the surface to a depth only sufficient to tap the sub-soil or ground water.

The vast majority of village wells in India are shallow wells and are liable to three forms of pollution. First by contamination of the springs from neighbouring cess-pits or the like, secondly by seepage from the area immediately surrounding the well, and thirdly by direct pollution introduced by solid vessels or from people entering the water. This last danger may be dealt with at once. In Chapter II under the section, Guinea Worm,

the danger of step-wells has been explained. Step-wells are large excavations, with steps leading down into the water. Such wells must be completely done away with. They are terribly dangerous, subject to every form of pollution and the special home of the guinea worm. These wells must be closed permanently or if this is not practicable, they must be fenced in, the steps removed and the water purified. The well should then be converted into a draw-well, by the provision of suitable pulleys for drawing water, or a pump. The step-well as such is a public danger that must be eliminated.

Shallow wells kept under reasonable supervision and treated with permanganate of potassium at regular intervals, as described in the chapter on cholera, must remain the main source of drinking water in villages, and can be rendered reasonably safe. First of all the locality must be studied and any manure heap, cess-pit or similar source of pollution of the sub-soil water in the neighbourhood, must be done away with. In cases of doubt the addition of fluorescein to the suspected source of contamination will, if pollution is occurring, produce fluorescence in the well water.

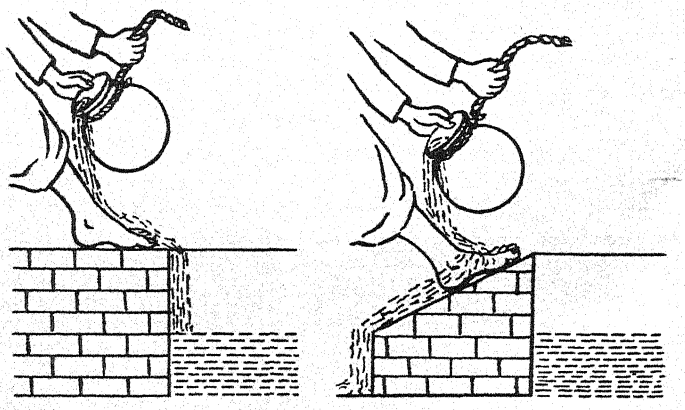
Pollution by seepage from the area around the well must be prevented by making the surroundings of the well dry and clean. The area that needs special care is a circle, with the well as the centre and a radius equal to the depth of the well. The inverted cone, of which this area is the base and the bottom of the well the apex, is known as the cone of absorption. Any foul moisture in this area seeps through the ground and is apt to pollute the water. Cattle-standings, drinking troughs for animals, houses, washing-places, drains and the like must be definitely excluded from this circle.

Lastly the water in the well must be protected. The lining of the well should be watertight masonry to below the lowest water-level, and carried up to a coping two or three feet above the ground-level. The top of this coping must be bevelled on the outer surface so that drippings

from the vessels used in drawing water will flow outwards and not trickle back into the well. This also prevents people standing on the well curb, or resting soiled vessels on it. Around the well-head a watertight masonry pavement is essential and this should slope away from the well and be provided with suitable drains to carry spilled water well outside the area of absorption.

Suitable pulleys should be arranged so that in drawing water the rope does not wear away and gradually break down the sharp upper edge of the coping. In any case the upper course of masonry should be of stone.

At the risk of being wearisome it is necessary to stress the importance of the bevelled edge. The diagram below illustrates the simple construction of the well curb recommended with its advantages.



(*a*) (*b*)

In (*a*) the well is infected from surface washings. The bevelled edge in (*b*) protects the water from pollution.

A plan showing a standard pattern of well is given after page 90. All wells used for drinking water should be designed to include the main points illustrated in this plan. The parapet wall of the well curb is sloped

outwards, so as to prevent water dribbling back into the well. This sloping surface also prevents vessels being placed on the well curb.

This type of well is not expensive and can be constructed in every village. The masonry is stone in lime, or where bricks of a good quality are available, brick masonry can be adopted, but the actual sharp angled curb and the sloping foot-plate are best in stone.

Having prepared a well that is moderately safe from pollution from dripping, and spilled water, every possible precaution should be taken to prevent pollution by the general use of domestic, and often dirty, vessels for drawing water.

A pump of a simple and fool-proof pattern is the ideal, but experience has shown that such a pump is rarely available for use in villages.

Apart from mechanical and financial difficulties, which are not readily overcome, there remains the important difficulty of caste. Many Indians will not drink water that has touched leather, so the pump must be made without any leather washers, and when this objection has been overcome, many more will object to using water from a pump operated by people of a different caste. In villages one is driven to accept the rope and bucket as the ordinary way of drawing water. It is very desirable that the use of private domestic vessels be discouraged, and it would be beneficial if a special iron vessel and chain for drawing water were fixed to each pulley scaffolding, and the use of all other vessels forbidden—an interdiction that can only come from public opinion, which needs much fostering in villages.

During an actual epidemic of cholera the rule that domestic vessels from infected houses must be kept far away from the well is one of the essential precautions that must be insisted upon. This necessitates supervision and the provision of a man of suitable caste to draw water for all. The recommendations given under cholera

postulate constant supervision in every village as long as cholera cases are occurring.

Tube-wells and bore-wells which may go to a great depth, and may tap water under pressure and become artesian, have great advantages in avoiding the dangers of pollution. Tube-wells however require a pump with the disadvantages already noted; and the geological conditions suitable for deep borings are not commonly available.

In factories and coolie-lines tube-wells are coming into use and the extension of this type of water-supply to villages should be encouraged wherever possible.

A simple form of short tube and pump is much used in river beds as a temporary measure during festivals and fairs. These tubes give cool and clear water and are a very valuable safeguard in discouraging the drinking of polluted river water.

Village Latrines

In constructing village latrines there are some points worthy of attention. It is desirable that

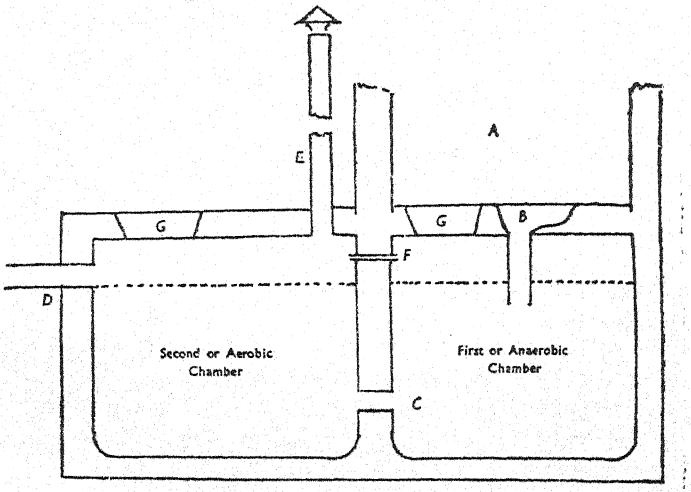
1. The latrine and its site are acceptable to the people.
2. It should require the minimum of attention and supervision.
3. The latrine and its surroundings should be such as are easy to keep clean.
4. The surroundings must be dry and unsuitable for the development of hookworm.
5. The question of conserving excreta for manure has to be considered.

All these conditions, except the last, are easily obtained if the aqua privy type of latrine is constructed. This is a design widely introduced in the Hyderabad Dominions. Detailed plans are given on page 79 and after page 90.

The principle on which the aqua privy works is the complete digestion of fæcal matter by anærobic bacteria, i.e., organisms active only in the complete absence of

oxygen. The structure consists of one or more seats with a four-inch pipe leading to a tank, called the first chamber. The pipe from the seat is continued to four inches below the surface of the water in the first chamber. A submerged connexion leads from the first to the second chamber at a level eighteen inches from the bottom of the chambers. This situation permits fluids to pass freely between the chambers, is sufficiently low to avoid surface currents and sufficiently high to allow for the gradual collection of heavy insoluble particles in the form of sludge.

AQUA PRIVY



The details of the aqua privy diagram are

A is the enclosed latrine proper and may be provided with any suitable superstructure.

B is a porcelain 'Indian pattern' seat with an air-tight connexion to the four-inch glazed pipe leading below the surface of the fluid in the first

chamber, and constituting an efficient trap which prevents the return of objectionable gases. The seat should be as far as possible funnel shaped.

C is a free connexion allowing fluid to pass from the first to the second chamber.

D is the waste pipe. The effluent will of course be equal to the quantity entering the first chamber at *B*.

E is a tall ventilating shaft inducing a current of air entering at *D* to play over the surface of the fluid in the second chamber.

F is a small gas tube, $\frac{1}{4}$ inch in diameter, essential to allow gases formed in excess in the first chamber to escape. This provision is essential as gases are formed in the first chamber, and if not provided with a means of escape, would depress the fluid in the first chamber and allow unpleasant gases to escape through the pipe *B*.

GG are the manholes provided for periodical cleaning. These must be firmly cemented down and gas-tight.

When properly constructed, water- and gas-tight, latrines of this kind work automatically with the minimum of attention. The diagram shows only one seat, but it is obvious that by enlarging the tanks in proportion, any number of seats can be provided above the first chamber. Only one pipe *C*, one outlet *D* and one gas pipe *F*, need be provided even in large latrines. Where the surface of the second chamber is large two ventilators *E* are provided.

The two chambers are of equal size and, up to water-level, must allow two cubic feet of content for each user. During construction, before the chambers are covered, careful tests are necessary to ensure that both are water-tight. When completed the two chambers are filled with water and the latrine can be used at once with no further preparation. In a few day the oxygen of the air in

the first chamber is exhausted and replaced by a mixture of gases with encourages the development and activity of anærobic bacteria. These gases digest fæcal matter, and the results of this digestion in water gradualy pass into the second chamber.

In the second chamber the superficial currents of air encourage the action of ærobic bacteria, that is organisms that are active in air. These complete the digestive process.

The fluid, or effluent, which dribbles out of the water-pipe *D* is equal to the amount entering the structure at *B*. This effluent should be clear as water, and if the whole privy has been properly constructed, it will leave no stain when tested on blotting paper. It is well to let the effluent drip into a masonry drain, carried with a good fall for about ten feet, for disposal in a patch for flowers or vegetables.

Difficulty was experienced in persuading sanitary engineers that the aqua privy would do what was claimed for it, and in persuading municipalities to prefer this type to the septic tank latrine. It may be positively asserted that once an aqua privy has been constructed efficiently and seen in use, there will be no desire to return to the older patterns.

In a large missionary institution one of these aqua privy latrines was constructed for the use of 500 boys. No trouble was experienced in providing the small amount of attention required. The installation was perfectly satisfactory, the absence of the usual latrine smell was very noticeable and much appreciated, and the effluent was disposed of in a vegetable garden. After three years of constant use it was decided to open the chambers and remove sludge. This was done but the amount of sludge found was small, well below the connecting pipe. It was obvious that the opening and cleaning out could well have been postponed for another two years.

It is difficult to write too strongly in favour of this system. A pattern for household use, that is, up to

eight users, can be and is being made in concrete in one unit. One of these, constructed of a three-foot cylinder with suitable partitions and pipes, has been in regular use for some years at the Hyderabad Isolation Hospital. A professor of hygiene who applied the blotting paper test to the effluent found it difficult to believe the clear fluid to be the result of fæcal digestion.

Most Indian villagers take a *lota* of water to the latrine for ablution purposes. This results in the addition of about a pint or at most two pints of water for each user. Experiments have shown that the addition of a gallon or a gallon and a half of water for each user does not interfere with efficiency, but a large excess of water causes too rapid a flow through the structure to permit of complete digestion. Where stones are used and dropped into the chamber, obviously more frequent openings will be necessary.

The aqua privy does fulfil the objects of a village latrine. The site should be selected with the approval of the people. The design of the superstructure should be according to local prejudice so long as it secures privacy and free ventilation. The women's latrine should not be too near that used by men.

All the attention necessary is that the village sweeper should visit the latrine once, late in the morning, and flush down the seats with water, and he should see that the surroundings are kept dry and clean. After two or three years the chambers should be opened, sludge removed and any necessary repairs carried out.

A disadvantage to this type of latrine is that valuable manure is lost. This disadvantage is discounted by the fact that in villages very little use is made of the manure from the older types of latrine. If it is decided that this cannot be sacrificed the authorities will be faced with the expense and the disadvantages of the bucket system, with the collection of fæcal matter and conservancy. The daily preparation and use of shallow trenches is then the best method, and ground so trenched yields excellent crops,

but considerable labour and regular supervision are required.

Shallow trenches should be dug fresh every day, twelve inches deep, twelve inches broad and long enough short trenches should be made. Night soil is put in, to a to take one day's supply. If the ground is sloping several depth of three inches, and the soil replaced leaving a slight mound. The trenches should be three feet apart. An area trenched in this way will yield wonderful crops and should not be retrenched for at least two years.

The Indore system yields valuable manure. Particulars can be obtained from Indore, but considerable expense is involved in making tanks, and in providing carts, animals and water. Efficiently carried out this is an excellent system for small towns where regular sanitary supervision is available, but it is doubtful if it can be applied in villages.

If adopted, those responsible for construction and control should visit Indore or some place where the system has been correctly organized and is working efficiently.

The obvious advantage of conserving manure and the attraction of a definite income to be made from the hire of trenched sites, or by selling compost, make a strong case for conservancy. It is the experience of those who know the Indian village best that, where manure from the latrines is collected, it is wasted in some hollow outside the village, and is a source of real danger at the latrine, during removal and at the cess-pit. In small villages the amount of manure will not pay for trained supervision. Where trained supervision is practicable, conservancy should be undertaken and properly controlled. Where such supervision is not available, that is to say in a very large proportion of Indian villages, it will be difficult to provide any better system than the aqua privy, or one that is more capable of preventing disease.

Large sewage systems are provided in many important Indian towns and with proper supervision are excellent.

APPENDIX

Anti-Plague Measures

THE work should be done in close co-operation with the local civil authorities and the people must be persuaded that the measures taken are necessary and will prove efficacious.

Women must be employed for inoculation and other work in purdah homes.

Imported infection is practically always due to the introduction of infected fleas in clothing, bedding and other personal property. The people must be convinced of the danger of entertaining visitors from infected localities.

All infected areas must be notified and the notification must remain in force until six weeks after the occurrence of the last case or rat-fall.

The anti-plague vaccine issued by Government is of proved efficacy. No other plague vaccine should be used.

Anti-Plague Inoculation

The strictest aseptic precautions must be taken.

Vaseline is the most convenient form of a sterilizing fluid as it is easily raised to a temperature of 160°C. and on cooling sets hard and travels easily. The needles can also be left in the vaseline where they remain protected from injury, rust and contamination.

If it is preferred liquid paraffin or olive oil may be used in place of vaseline, but in no case must water be depended on as a sterilizing fluid for inoculation.

The thermometer must be in good working order and the bulb covered by the sterilizing fluid during heating. When a temperature just below 100°C. is reached, the

syringe, without the needle attached, should be filled several times to ensure that it is working properly, and to warm the glass barrel so that it will not break when exposed to a higher temperature.

When the thermometer shows a temperature of 160°C. the syringe is sterilized by being filled and emptied three times. The needle, sterilized in the vaseline, should be applied with sterile forceps when the syringe is full, and the vaseline ejected from the syringe as completely as possible. A few cc.'s of the vaccine to be used should be drawn into the syringe after a short time has been allowed for cooling. The piston is then opened to the full extent and the vaccine ejected, carrying with it any vaseline left in the syringe. Traces of oil or vaseline may increase the local reaction in the first cases inoculated.

When the vaseline is satisfactorily ejected, the syringe is filled with the vaccine, the jockey ring fixed to mark the first dose, and the inoculation can proceed.

It is wise to dip the needle in hot oil after each inoculation and to cool it by ejecting a few drops of vaccine before proceeding.

After thorough shaking, the tip of the vaccine bulb is sterilized by passing it through a flame. While the tip is hot the fluid inside is jerked up against it and this readily breaks the nipple without any other agency.

The arm of the patient must be sterilized by applying tincture of iodine over the spot selected for inoculation. The iodine should be allowed to dry before the needle is introduced. Should a drop of blood issue from the puncture after inoculation a pledget of cotton wool, dipped in iodine, should be applied and allowed to remain.

The dose of vaccine can be ascertained from the bulbs. Persons enfeebled by old age may be given one-tenth less. Children should be given reduced doses in accordance with age, the minimum dose to be 1 cc. for a child of two years. A child of ten years will be given half a dose and children of sixteen years and upwards a full dose. The giving of small and inefficient doses must be avoided

as it is bound to bring discredit on the vaccine and on the medical officer concerned.

Pregnancy, except in the last month, is not a bar to inoculation, and owing to the special danger from plague to lying-in women, the inoculation of pregnant women is to be encouraged

Disinfection

Disinfection aims at the destruction of rat fleas. This includes

(a) Disinfection of clothes, bedding and property of infected persons and also of those coming from infected areas.

(b) Disinfection of infected houses.

Plague-infected articles can be rendered free of fleas by exposure to the direct rays of the sun for three hours.

For house disinfection kerosene oil emulsion is prepared as follows: Take four cakes of sunlight soap, slice them and add half a gallon of water and boil till the soap dissolves. Now place in an open tub and beat up the solution, gradually adding kerosene at intervals of one minute, seeing that all trace of free oil is absorbed into the frothy mass before fresh oil is added. After adding three gallons of oil proceed very carefully till the whole four gallons is added and absorbed. If properly done a half gallon of soap solution should emulsify four gallons of kerosene. The time taken to make such a mixture is generally about half an hour. This emulsion is used in dilution of one in ten and is to be thoroughly sprayed with a sprayer or watering-can all over the floor and walls of the room, care being taken to attack all corners and recesses.

Country tile roofs should be opened up sufficiently to admit direct sunlight, and infected thatch is better burned.

Rat Destruction

An epidemic of plague can only be severe when the rat population is large. Rats breed at a prodigious rate

and while it is impossible to exterminate rats completely from a locality, much can be done to reduce their number by continuous and systematic measures.

The chief methods are poison baits, trapping, and fumigation.

Poisoning is efficient and cheap. A satisfactory poison is barium carbonate which in the quantities used is harmless to children and domestic animals.

BAITING. The following formula is used

Barium carbonate	1 lb
Wheat flour	3 lb

The ingredients are well mixed in a basin, with the addition of sufficient water to make a fairly firm mass. This mass is divided into four thousand pills of uniform size, each pill or bait contains 1.9 grains of barium carbonate. Care should be taken to avoid contact with the hands.

The baits are freshly prepared every day. They should be laid in the evening in sets of two to six. It is not usually necessary to lay more than six in one room. There is no advantage in placing them near rat holes or runs. They are better laid behind boxes or furniture as if fallen by chance. Each day a different place in the room is selected. Each room is baited for three days. Obviously the number must be increased or decreased according to the size of the room and the rat infestation.

Early next day those remaining are collected and noted. During baiting no waste matter, rubbish or food should be left on the floor. At all times foodstuffs should be kept in rat-proof containers.

Special attention should be paid to cattle sheds, stables, cactus hedges, godowns, depots, dilapidated houses, and to dustbins and collections of rubbish.

TRAPPING. After three days baiting, trapping is recommended for two days. The most effective substances used as baits in the traps, in order of merit, are cucumber,

french beans, green chillies, sweet potatoes, *jalabies*, wheat flour, and coriander leaves.

Traps should be placed in dark places behind boxes, furniture or food stores. No trap should be placed near a rat hole or in an open space. The traps are distributed in the morning. The next morning all the traps are inspected, and any rats trapped are collected, the baits changed and the traps given back. After two days the traps are collected and distributed to the next set of houses. Traps should be washed once a week and daily put in the sun. One man is in charge of thirty traps on an average. The Hyderabad pattern of rat trap should be used.

Trapping is useful for classification and survey purposes, for computing the rat population during the destruction of rats by more efficient means, for establishing the flea index and observing the breeding seasons.

To eliminate rats with traps alone would require an enormous number of traps and a very large staff. Even then the method would be expensive and less efficient than when combined with baiting with barium carbonate and fumigation of rat-runs. When with efficient traps, correctly used, the number of rats caught daily in a hundred traps has fallen to ten there is no fear of any widespread epidemic of plague.

If any District Board wishes to organize systematic rat campaigns the following conditions should be insisted upon:

1. The measures should be carried out in accordance with the scheme approved by a plague expert and his advice should be followed throughout the period.

2. The measures undertaken should be continuous and sustained, and there should be real co-operation from the people and from the District Board.

3. The District Board should guarantee the continuance of the campaign for a period of three years.

Post-mortem Signs of Plague in the Rat

Naked Eye

Enlargement of the glands of the neck, axilla and groin.
Subcutaneous hæmorrhages.
Pericardial effusion.
The liver is enlarged, discoloured and hardened.
The spleen is enlarged.

Microscopic

A smear from the spleen or liver if stained with methylene blue or carbol thionine will show the bacilli.
Gram's method is useful for differentiation.

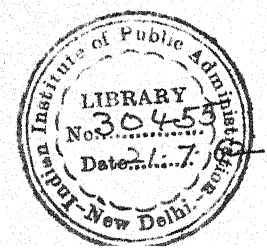
When *in extremis* rats come out of their holes to die in the open. It has been noted that fleas are attracted in large numbers to rats dying of plague. Handling a rat which has died of plague is dangerous. Any rat found dead should be lifted by metal tongs, placed in a tin with a little kerosene, covered and sent to the laboratory for examination.

Rules for Issue regarding the Use of Calcid

The regular use of calcid is quite safe. It is at the same time a poison and must not be used carelessly. It should be kept in a dry unused place, stored in air-tight tins, and kept out of the reach of children and irresponsible persons. Should a complete tin not be used up in one day, a strip of insulation tape or sticking plaster could be used to seal the tin after use. Dangerous quantities of gas are not given off from the tin though a smell of cyanide may be noticed. Briquettes can be handled with safety but it is quite unnecessary and inadvisable to hold them in the hand for long.

Besides the above precautions the following DON'TS have to be observed:

1. Don't fail to prevent any but specially trained men handling calcid.
2. Don't keep the tin open longer than is necessary.
3. Don't expose sores or cuts to the material.
4. Don't allow dogs or pets to approach during the operation.
5. Don't allow the room just attended to be reoccupied for at least two hours.
6. Don't allow the staff or attendants to smoke.
7. Don't leave any calcid dust in the pump when work is finished.
8. Don't fail to clean the pump after work is done.
9. Don't breathe in the gas.
10. Don't fail to wash your hands at once after working with calcid.
11. Don't fail to stand during operation in such a position that the wind will blow the fumes away from you.
12. Don't fail to inhale ammonia or amylnitrite if headache or giddiness or any unpleasant effects are noticed.
13. Don't start calcid fumigation until it is certain that no human beings or animals of any sort are inside the room to be fumigated, or on the other side of a wall. *All human beings or animals must be evacuated before fumigation begins.*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PLANS

T. B. CLINIC

INFANT WELFARE CENTRE

SLAUGHTER HOUSE

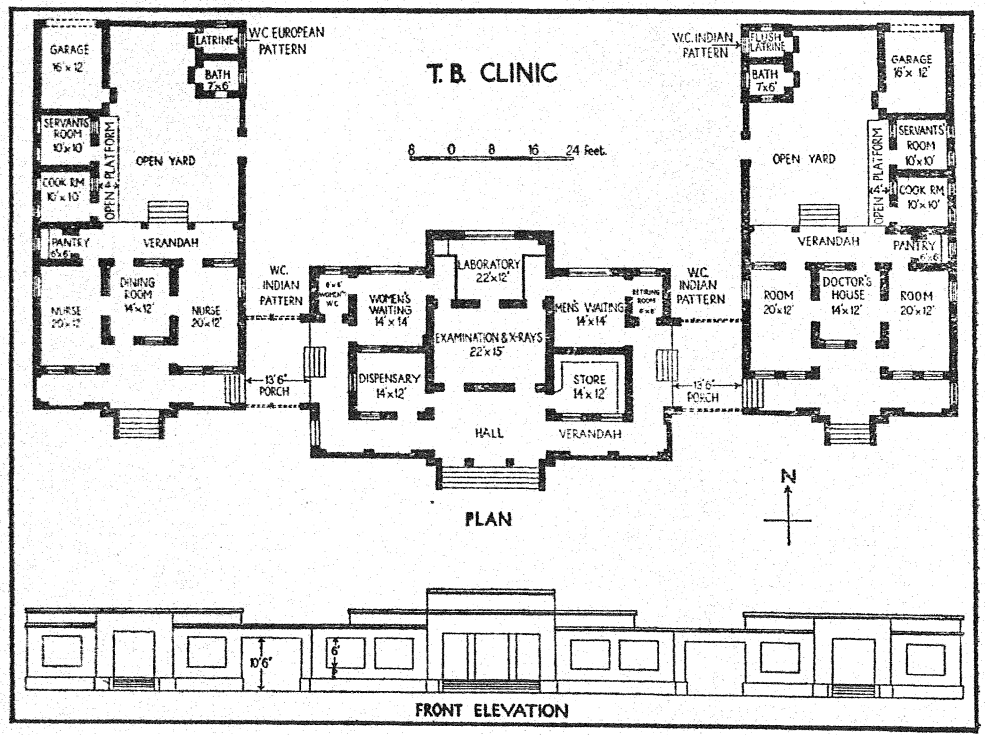
VEGETABLE MARKET

BEEF SHOP

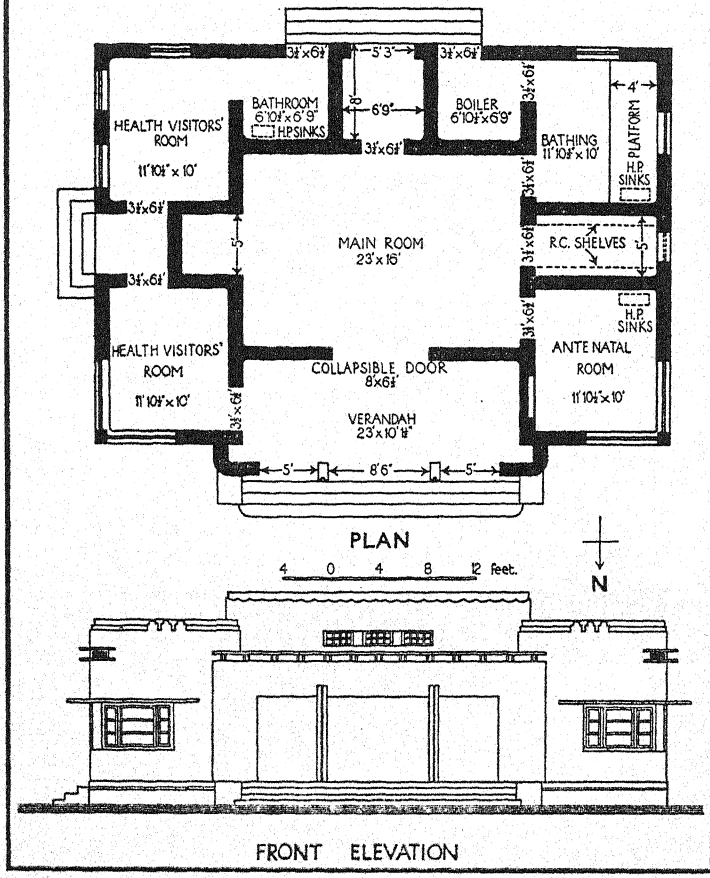
MEAT MARKET

DESIGN FOR 6 FOOT DIAMETER WELL

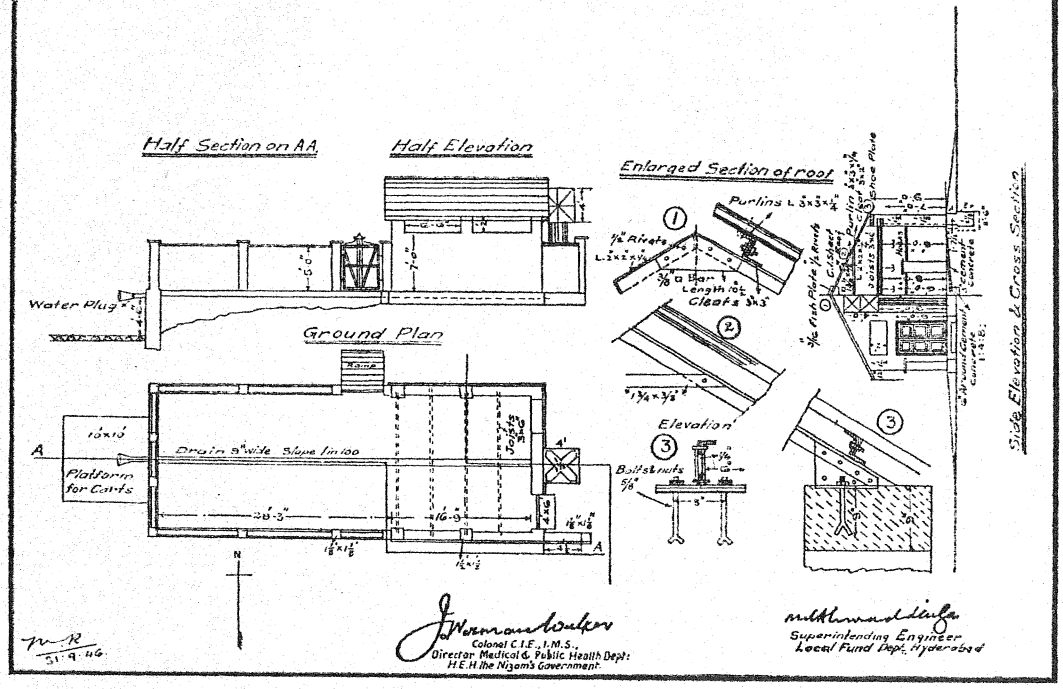
AQUA PRIVY


T. B. CLINIC
8 0 8 16 24 Feet.
GARAGE 16'x 12'
LATRINE
W.C EUROPEAN PATTERN
BATH 7'x6'
SERVANTS ROOM 10'x10'
OPEN PLATFORM
OPEN YARD
COOK RM 10'x 10'
PANTRY 6'x6'
VERANDAH
DINING ROOM 14'x12'
NURSE 20'x12'
NURSE 20'x12'
13'6" PORCH
W.C. INDIAN PATTERN
6'x4' WOMEN'S W.C
WOMEN'S WAITING 14'x14'
LABORATORY 22'x12'
EXAMINATION & X-RAYS 22'x15'
DISPENSARY 14'x12'
STORE 14'x12'
HALL
VERANDAH
MEN'S WAITING 14'x14'
RETIRING ROOM 6'x8'
W.C. INDIAN PATTERN
13'6" PORCH
W.C. INDIAN PATTERN
FLUSH LATRINE
BATH 7'x6'
OPEN YARD
VERANDAH
ROOM 20'x12'
DOCTOR'S HOUSE 14'x12'
ROOM 20'x12'
GARAGE 16'x 12'
SERVANTS ROOM 10'x10'
OPEN PLATFORM
14'+
COOK RM 10'x 10'
PANTRY 6'x6'
N
PLAN
10'6"
6'
FRONT ELEVATION

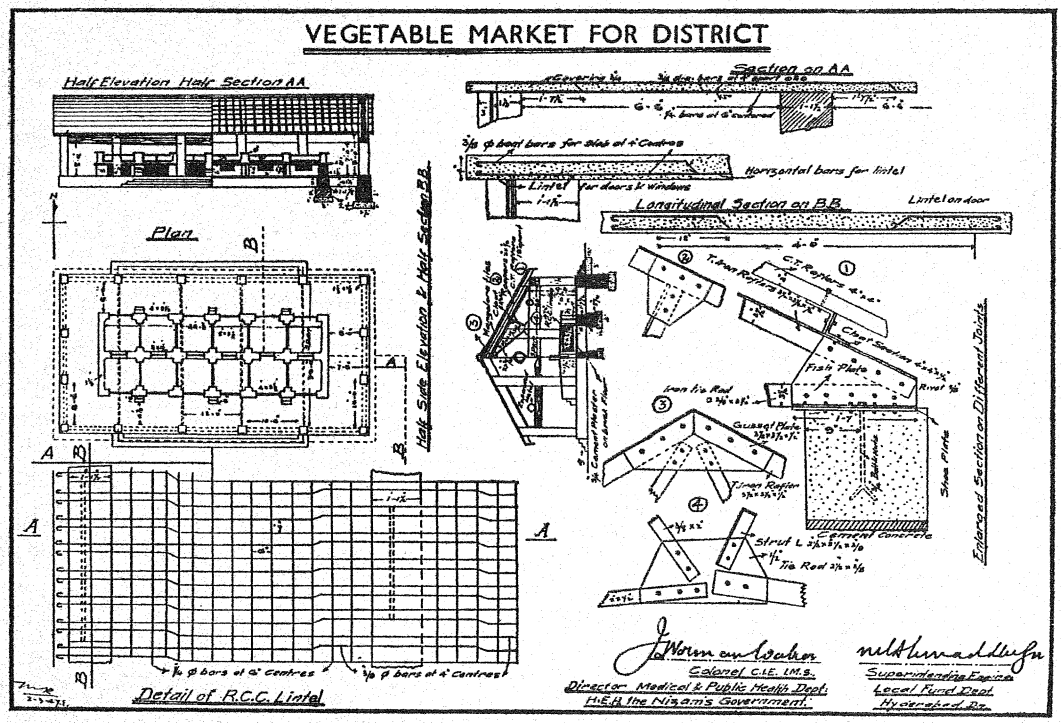
INFANT WELFARE CENTRE



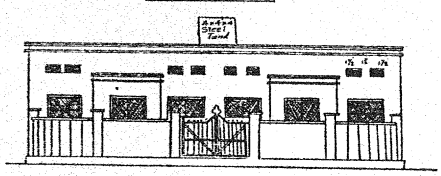
SLAUGHTER HOUSE

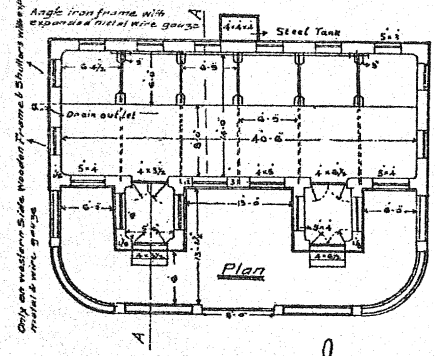


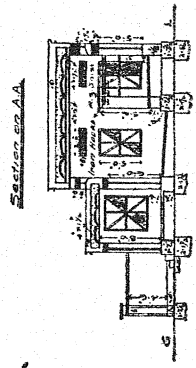
VEGETABLE MARKET FOR DISTRICT

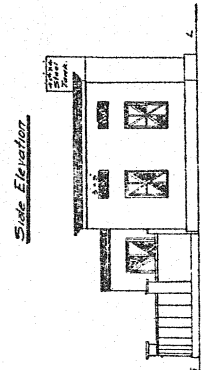


BEEF SHOP FOR DISTRICT









J. Warren Walker
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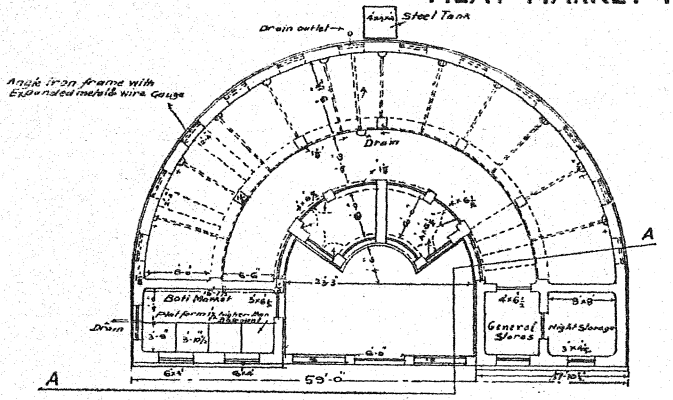
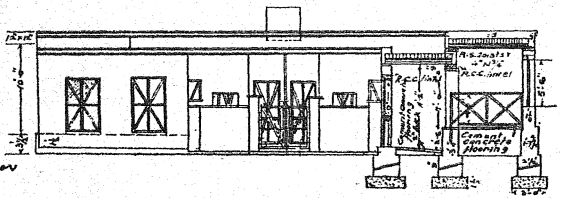
Director Medical & Public Health Dept.
H.E.H. the Nizam's Government.

Superintending Engineer
Local Fund Department
Hyderabad Dn.

MEAT MARKET FOR DISTRICT



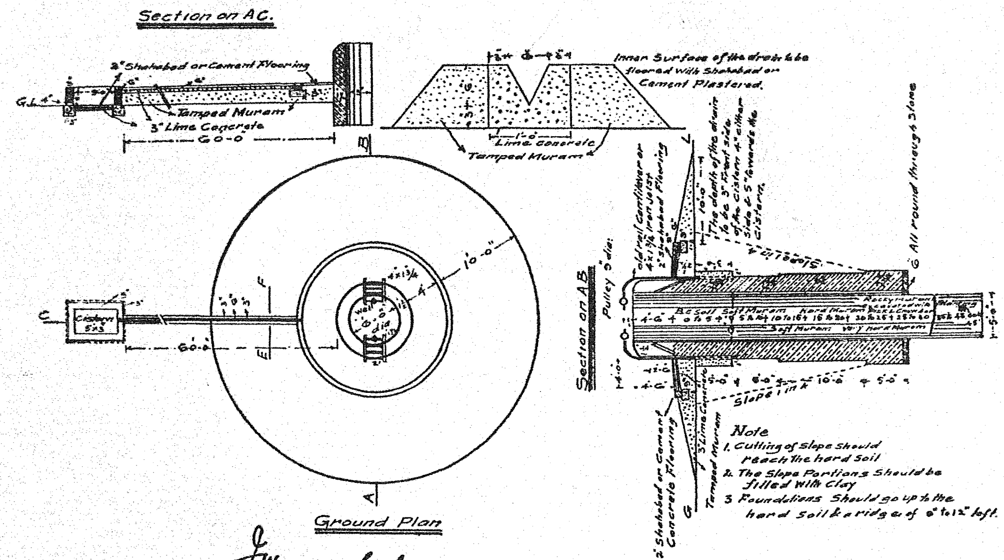
Half Elevation & Half Section on AA



J. Warren Baker
Colone: C.I.E., I.M.S.,
Director Medical & Public Health Dept.
H.E.H The Nizam's Government.

Sk. Md. Ahmed Mirza
Superintending Engineer
Local Fund Dept. Hyderabad

DESIGN FOR 6 FOOT DIAMETER WELL



Note
1. Cutting of Slope should reach the hard Soil
2. The Slope Portions Should be filled with Clay
3 Foundations Should go up to the hard soil & a ridge of 6" to 12" left.

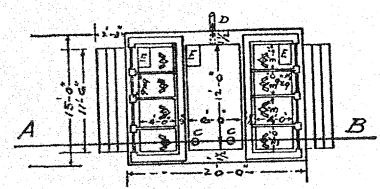
J. Norman Walker
Colonel C.I.E. I.M.S.
Director Medical & Public Health Dept.
H.E.H. The Nizam's Government

M. Ahmad [signature]
Superintending Engineer
Local Fund Dept: Hyderabad

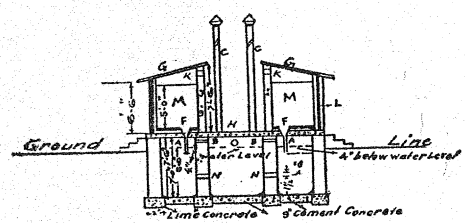
10-6-47 F.

AQUA PRIVY

Ground Plan



Section on AB



Reference

A. 3½ S.W. Pipe sealed to seat extends 4" below water level.
B. ½" Gas Pipe.
C. Ventilating shaft 6" dia. 14' long
D. Effluent Pipe 6" dia.
E. Sealed manhole
F. Squatting Pan
G. 5" R.C. Concrete roof
H. 6" R.C. Concrete slabs
J. 9" Brick Wall
K. Ventilator 2'×6"
L. Sheet iron door
M. 2" R.C. Concrete Partition Wall.
N. 6" S.W.G. Pipe

S/D. C.F. Cheney 1-8-46 F.
Deputy Director of Public Health Dept.
H.E.H. the Nizam's Government.

2-10-46 F.

Colonel, C.I.E., I.M.S.,
Director Medical & Public Health Dept:
H.E.H. the Nizam's Government.